GJTRACKER

HELP and USER MANUAL for Version 3.0, March 2, 2016

SYSTEM REQUIREMENTS AND SETUP

A GJTRACKER is written in Visual Basic 6.0, to run on Windows operating systems. If you do not already have the required files to run VB6 programs, it may be necessary to download the update file from Microsoft:

http://support.microsoft.com/kb/290887

B Upon running GJTRACKER, you may receive a message that your computer cannot find a certain Microsoft file in your operating system. The two such missing files I have encountered so far were MSSTDFMT.DLL and COMDLG32.OCX. For your convenience, I have included those two files with this distribution. If you do receive an error report about missing one of these files when you first try to run GJTRACKER, follow these steps for each of the files (example only shown for comdlg32.ocx, but you would simply do the same thing with msstdfmt.dll if you also need to install that file):

1. Move comdlg32.ocx to c:\Windows\system32 folder. For all 64bit Windows operating systems, instead save comdlg32.ocx in c:\Windows\SysWOW64

2. In the Windows START area, press the START and RUN buttons to open the Start, Run dialog window to provide a Command prompt, and enter:

   regsvr32 c:\Windows\system32\comdlg32.ocx

   Note: a) On 64bit Vista/Win7, run this command instead:

   regsvr32 c:\Windows\SysWOW64\comdlg32.ocx

   Note: b) For Vista/Win7 with UAC turn on, the above command needs to be run from elevated command prompt.

3. Once comdlg32 is registered successfully, following message will prompt:

   "DllRegisterServer in C:\WINDOWS\System32\comdlg32.ocx succeeded"

4. Now launch the application again you should not see file missing error.

NOTE: If you instead receive an error message such as the one below, it is probably because you needed to run the regsvr32 command as "Administrator", or the file was saved into the wrong folder:

"The module "c:\windows\system32\msstdfmt.dll" was loaded, but the call to DllRegisterServer failed with error code 0x8002801c"

The specific steps to go through to properly register the file varies slightly depending on your Windows operating system, and you can obtain the specific instructions by doing a Google search on the operating system and error code displayed in the message. However, to get around the problem in Windows 7, follow these steps:

1. Go to Start Menu > All Programs > Accessories
2. RIGHT_ click 'Command Prompt', and choose 'Run as administrator'

3. Enter the regsvr32 command in the new command prompt box

In some versions of Windows, you may have to run the program "as administrator" or with special permission assigned to the program in order for it to function properly. In such cases, check for HELP in the operating system on how to modify the security settings for the programs.

C Since the HELP file is in PDF format, it also is necessary to have a reader for Adobe Acrobat PDF files. If you don't already have such a program installed on your computer, please download a free reader from:

http://www.adobe.com/

Once you have installed the current Adobe Acrobat reader on your computer, you will have to find the correct path to the reader and install that in the GJTRACKER.DAT file. You can do this when you run GJTRACKER and enter it into the box by toggling the TEXT EDITOR entry field in the lower right corner of the screen.

INTRODUCTION TO GJTRACKER

You are running Version 3.0 of GJTRACKER, originally prepared in October, 2008 (and subsequently updated) for the Windows operating systems. GJTRACKER is based on previous FORTRAN and BASIC versions of the program TRACKER, which was first written in 1973 to fulfill an urgent need among amateur radio operators for a moon locating program. The program is especially useful for determining common moon "windows" when two stations can see the moon at the same time.

The program has been written to use the same format callsign file CALL3.TXT and REAL-TIME mode output text file (GJAZEL.DAT) as the WSJT program developed by K1JT. Because of this, GJTRACKER can be installed into the same file folder as is being used for the WSJT programs, and programs utilizing that format for real-time tracking can also be used with GJTRACKER.

This program is share-ware. Donations and suggestions from users regarding program use and/or desirable enhancements are welcomed.

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GENERAL PROGRAM NOTES

GJTRACKER is an advanced accurate program for tracking the moon, sun and celestial noise sources for amateur radio operators. Originally written in DOS, this version was re-written by W7GJ in Visual Basic 6, for use in computers running the Windows operating systems. This program provides accurate local tracking data for chosen celestial objects for any date from any point on the earth. Since it was originally written for use by amateur radio operators engaged in earth-moon-earth (EME) communications, some of the features have been specifically designed to provide data which is in the most useful format for that application.

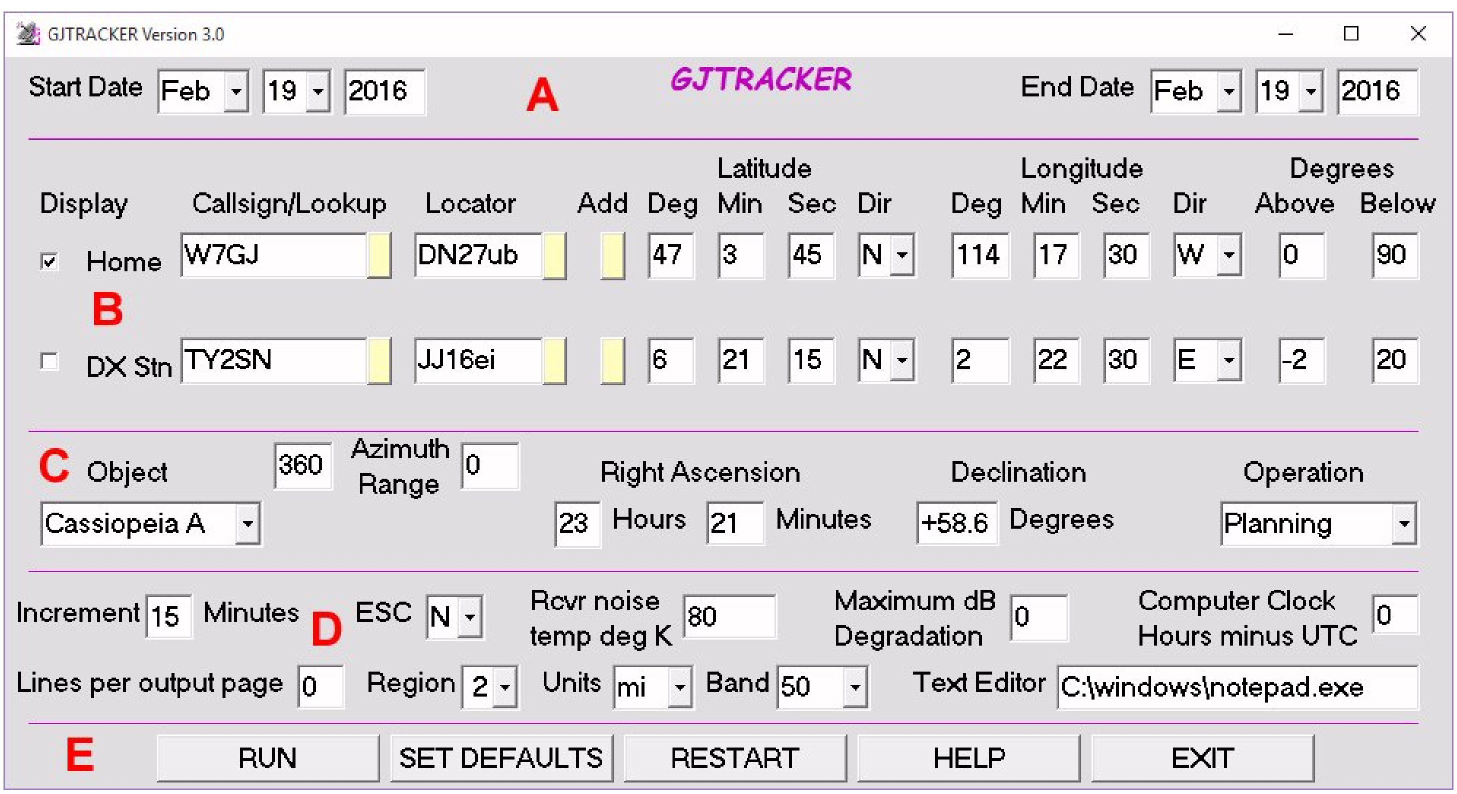
GJTRACKER uses the following files, all of which are normally installed in the same folder.

CAUTION: Do not install GJTRACKER into the same folder already containing a file named CALL3.TXT unless you want it to be replaced by the version of CALL3.TXT included in the GJTRACKER distribution.

FILE NAME	DESCRIPTION
GJTRACKER.EXE	VB6 tracking program designed for use with Windows O/S environments
GJTRACKER.DAT	Text file storing default startup variables
CALL3.TXT	WSJT-compatible text file storing file of active VHF/UHF stations and their grid locators
GJHELP.PDF	Adobe Acrobat file containing detailed program use instructions
GJSKYTEMP.DAT	Text file containing data of approximate sky temperature data for use in moon tracking
GJREADME.TXT	Text file of essential tips to installing and running the program initially
GJTRACKER.ICO	Optional icon for use with a shortcut.
GJTRACKER.TXT *	Text file containing tracking data output from each program run when operated in the PLANNING mode.
GJAZEL.DAT *	Text file containing UTC, azimuth, elevation and name of the celestial object being tracked, followed by GHA and DECLINATION. It is updated every 60 seconds when operating in the REAL TIME mode.

* These files are generated by the program each time it is run.

The main program features are fairly self explanatory through the use of mouse tool tips and automatic processing. However, the following notes may be of assistance in understanding some of the general program features. The main input screen is used to both display information and select stations for which positions will be calculated. The screen is divided into five horizontal sections, as shown in the following figure:



SECTION A

The START DATE for operation in PLANNING mode is selected in the upper left corner of the screen. The END DATE is specified in the upper right corner. The one year limit restriction has been removed in Version 3.0, so you can examine multiple years at once if you wish – right up to the overflow permitted by your computer.

In the center of the screen just below the program title is the SEARCH STATUS field which displays the record number when a callsign search is successfully performed in the file CALL3.TXT.

SECTION B

This section is used to specify which station locations are to be displayed and included in the tracking calculations. Only one station can be selected for display at a time if the program is operated in PLANNING mode and an object other than the moon is chosen. Otherwise, up to two stations can be selected for display during either PLANNING or REAL TIME operation.

Specifying a callsign, grid locator and geographical coordinates can be done either manually, or automatically by looking up the callsign in the file CALL3.TXT. Pressing the light yellow button after the callsign entry field will look up the callsign, insert the appropriate grid locator, and calculate the corresponding latitude and longitude for that station. Similar results are obtained if the ESC key is pressed after entering the callsign of interest. If a callsign is found in CALL3.TXT, the NOTES for that station are also displayed. If a searched callsign is found in the file CALL3.TXT, the Locator will be automatically entered and the corresponding coordinates calculated and displayed.

You can search for stations by entering the "Wild Card" indicator of "*" in your callsign. Since all the callsigns in the file CALL3.TXT are alphabetically stored, GJTRACKER will display the first callsign in CALL3.TXT that matches all characters preceding the "*". This is very convenient if you are just interested in finding common window times with a certain DXCC, for example.

Once you have found a callsign and the "Exact Match" message is displayed in the search status field (described in Section A above), the callsigns in CALL3.TXT can be sequentially browsed forward or backward. To display the previous callsign in CALL3.TXT, click on the callsign data entry field and press the left bracket key, "[". To browse past the displayed callsign, press the right bracket key, "]". Note that you must have the ESC key option enabled for the browse function to work – see Section D below.

If the station of interest is not saved in the file CALL3.TXT, you can enter the grid locator manually. Pressing the backspace key will erase everything in the callsign and grid locator fields. To calculate coordinates for a new grid locator, the light yellow button at the right end of the grid locator field or the ESC key is pressed.
If the grid locator is not known, the latitude and longitude can be entered manually. In this case, if the locator field is blank, but the coordinate fields are complete, pressing the locator calculate button (or the ESC key while in the locator field) will calculate the locator. If the latitude or longitude is entered in decimal degrees, the minutes and seconds fields will be ignored when the locator is calculated according to the decimal degrees.

If a new callsign and grid locator are to be added, or an existing callsign is to be modified or deleted in the file CALL3.TXT, the ADD button to the right of the grid locator field is pressed. The following screen will pop up for you to confirm that you want to make the changes exactly as they are shown.

At the right end of Section B are columns indicating the elevation limits for the output display of positions both stations. If you want display of position calculations whenever the moon is above the horizon, you would enter 0 degrees in the ABOVE column and 90 degrees in the BELOW column. Actually, if a station has QTH with a negative horizon, you can also enter a negative number for the ABOVE elevation. These limits only apply to the printed output during the PLANNING mode. During REAL-TIME mode, even negative elevations are displayed.

Note that if moon positions are calculated in the PLANNING mode for two stations at once, the only positions displayed are for those times at which BOTH stations can see the moon. Therefore, the program is quite useful in showing common moon windows between two stations, particularly if one or both are limited to the horizon and can only operate EME when the moon is below 20 degrees.

SECTION C

One of the changes in Version 3 is the ability to specify an optional AZIMIMUTH RANGE in degrees for which you want to display coordinates for the moon or other object of interest. The right azimuth range box is the most eastern azimuth value at which you want to start data output. Similarly, the left azimuth range box is the most western azimuth that you want displayed. Normally, you would want to see all data as the object traverses the sky, so you would leave the defaults as shown. When 0 is the eastern azimuth and 360 is entered for the western azimuth, the optional range is bypassed, and all azimuthal angles are displayed for whatever object you have selected.

The above references to “east” and “west” refer to the movement of the object which you are tracking. Therefore, imagine the object as it moves from rise to set. If the declination of the object you are tracking is greater than your local latitude, you will follow the object in a counter-clockwise direction through the northern sky, and if its declination is less than your latitude, you will be following it in a clockwise direction across the southern sky. You can enter appropriate eastern and western azimuth limits according to these motions. You also can use these boxes if you want to restrict moon data output to times when the moon is visible between mountains, or large buildings obstructing your local view.

In Version 3, the option for restricting data output to only particular GMT times also is available by entering the beginning and ending GMT times desired. This option is displayed by clicking on the range label between the two boxes, to toggle between it and the optional azimuth range settings. If you have RESET these defaults, your new values for those optional range parameters will be stored along with all the other default settings in file GJTRACKER.DAT and recalled the next time you restart the program.

Section C of the input screen is also where you select the celestial OBJECT for which you want to calculate positions. If you select either the MOON or the SUN, their positions are completely calculated by the program. If you select another “fixed” celestial object, the RIGHT ASCENSION and DECLINATION are shown for that object. If you want to track an object that is not shown, select OTHER for the OBJECT, and then enter the name of the object, along with its RIGHT ASCENSION and DECLINATION.

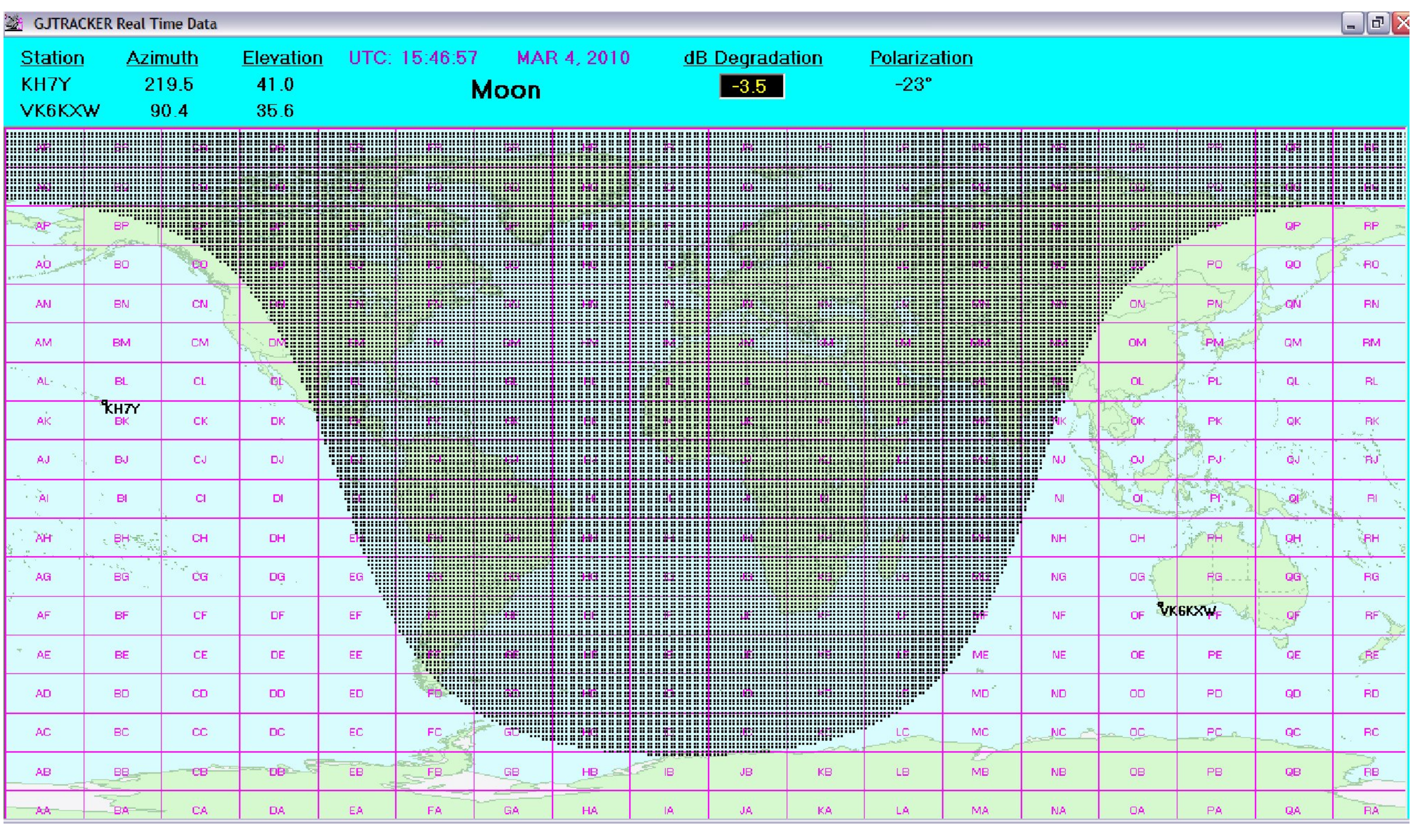
At the right side of this section, you can specify the OPERATION mode of the program. If you select PLANNING mode, the positions of the object above the elevations you have specified in Section B are displayed in the text file GJTRACKER.TXT, for all the days between the dates entered in Section A. The output file "GJTRACKER.txt" will automatically be opened at the end of computation, using the Windows text editor program, "Notepad". At that point, the file can be printed, scrolled through for reading, renamed and saved and/or sent to a sked partner.

If "REAL TIME" mode operation is selected, current tracking data (updated every minute) for up to two stations is displayed in a separate window which pops up at the time the "RUN" button is pressed. The aiming data for the home station is also stored every minute in the text file GJAZEL.DAT. The name of the object being tracked is shown below the current UTC time and date. All elevations are shown for the station(s) selected by checking their DISPLAY boxes, and negative elevations are highlighted in red. The callsigns(s) of the stations selected for display are shown at their appropriate location(s) on the map, and the map is shaded to show the part of the world where the moon not is not visible at that time. The map and the terminator for whatever object is selected is displayed regardless of the number of stations that also are selected.

If the MOON has been selected for tracking, the difference in polarity due to geometry between the two stations is displayed in the lower left corner of the Real-Time screen. Similarly, for MOON tracking, the approximate geometric DEGRADATION is shown for the frequency band specified by the user.

The moon passes through different portions of the sky and its distance changes as it orbits the Earth every month. A DEGRADATION of zero corresponds to the ideal situation when the moon is at its closest approach to Earth at the same time that it is in front of the quietest portion of the sky. This ideal situation is rarely encountered, although some days are definitely better than others. The approximate DEGRADATION displayed on the map is color coded according to the following schedule:

zero to -2 dB is green, -2 to -4 dB is yellow, -4 to -6 dB is orange and Degradation greater than 6 dB is red



As you can see from the previous photo of the Real Time window, the data is displayed above a world map (courtesy of DX Atlas), upon which is displayed the approximate “terminator” for whatever object has been selected. As with the data at the top of the screen, the map is updated at the beginning of every minute. To view the entire world map, it is necessary to use a monitor capable of displaying at least 1280 by 768 pixels.

SECTION D

This section contains most of the settings that apply to the user’s own particular station, and will not usually be changed very frequently once they are properly set. The INCREMENT can be anything from 1 to 60 minutes, and determines how often positions are displayed when in the PLANNING mode.

Similarly, the LINES per output page applies to the PLANNING mode output. If the output is to be printed from NOTEPAD, a LINES value of 63 will create a new heading at the top of each page. A value of zero is typically used for visual examination of the output on the screen, or for creating a text file for sending to another station.

The ESC box allows you to select whether you want to enable the ESC KEY to be used to exit the callsign and locator boxes and automatically cause these to be looked up and re-calculated. When the ESC KEY is activated, each character is examined as it is entered, and it is reformatted as it is entered. If the ESC KEY is not activated, the callsign and locator fields can be entered in either upper or lower case letters, and edited as usual, and they are not re-formatted until the button to the right of each box is pressed. If the ESC box is enabled, you also have the option of sequentially scrolling through your call3.txt file with the bracket keys when you are in the callsign entry box. Pressing the left bracket key “[“ moves to the earlier callsign record and pressing the right bracket key “]” advances to the next callsign in the database.

The REGION is the IARU region of the home station. This value will be used to select the various activity windows when MOON positions are calculated. The UNITS can be selected for the display of the distances during the PLANNING mode output. Both the RCVR NOISE TEMPERATURE and the BAND selections are used in the calculation of the approximate DEGRADATION. If you enter a value other than zero in the MAXIMUM DB DEGRADATION box, printout of data will be limited to times when the DEGRADATION is less than the number you specified. This allows you to conveniently search for the optimum operating windows between chosen stations.

At the upper right end of the section is the place for the user to enter the difference between local time zone and UTC. If the user’s computer clock is set to display UTC, this value would be specified as number “0”. If UTC is 4 hours ahead of the local time kept by your computer, you would enter “-4” hours here. Usually the user would specify full integer hours here, but the program will also accept fractional hours (for those special cases in which there is other than an integral hour difference from GMT).

In the lower right end of this section is a place where you can specify a different path and program as a default TEXT EDITOR to display the output when operating in PLANNING mode. By clicking on the label TEXT EDITOR, you can change this to display the default program and path for the program used to display the PDF help file. If you do change either of these paths to the respective programs, be sure to save them by pressing the SET DEFAULTS button at the bottom of the screen.

SECTION E

The bottom section of the screen contains the primary buttons for operating the program. Pressing the RUN button initiates calculations according to the parameters chosen in the above sections. Pressing the red STOP button during the REAL TIME MODE curtails the calculations, closes files and permits the user to change any parameters on the screen. The SET DEFAULTS button reads all the values entered on the screen and saves them so that will be the way the program starts the next time it is run. Pressing RESTART clears the screen and re-loads the saved startup parameters just as if the program is exited and restarted again. Pressing the HELP button opens the Help/User Manual at GJHELP.PDF, using the path and Adobe reader specified in the above section. Pressing EXIT closes files and exits the program, freeing up dedicated memory space for other applications.

PLANNING MODE OUTPUT FILE

The format of the MOON data output in the file GJTRACKER.TXT is shown and discussed below. In the first example, some common moon position data is displayed for two stations, W1JJ and W7GJ. You will see the azimuth and elevation for each station below the clearly labeled headers for each location. These columns are separated by the lunar DECLINATION column. The DECLINATION is a very important value, and describes the angular distance from the “celestial equator”. The moon moves north and south of the celestial equator over the course of each month, similar to how the sun moves on an annual basis. As a result of this movement, common windows between different locations on the earth change every day.

Because both stations were chosen for DISPLAY, the terrestrial distance between the two stations is also shown (at the left end of the fourth header line from the top of the page). Also note that the units shown for this distance, as well for the moon distance, or RANGE (right end of the top header line), are in KM. These units are user selectable at RUN time.

Also notice that the right end of the second header line shows the number of days past perigee or apogee, followed by the semi-diameter of the moon in minutes of arc. The moon appears as approximately half a degree in diameter, and astronomers use the “semi-diameter” as a measure of the apparent size and distance of the moon. The approximate total DEGRADATION due to orbital mechanics and background sky temperature noise is shown in the final column for the frequency band specified at RUN time.

```
SEP 26,2008    41 ° 36' 15" N       MOON POSITION          RANGE:   379,127 KM
FRIDAY         71 ° 32' 30" W  (PREPARED BY GJTRACKER)     P +6 DAYS  15.76'SD
JD: 2454735.5  W1JJ NOTES:  ,RI,Mick,,50: 4x 9el  1500W
DX: 3,407.8 KM   (W1JJ in FN41fo)       (W7GJ in DN27ub)    APPROX  50   MHZ DB
UTC    NOTES    W AZIMUTH   ELEV    DEC   AZIMUTH ELEV POL  SKY °K  DEGRADATION
====  ========  = =======  ======  =====  ======= ==== ===  ======  ===========
1045               106.0    32.7    11.2     76.9   2.2   4   2368        1.3
1100               109.1    35.3    11.2     79.6   4.6   3   2368        1.3
1115               112.3    37.8    11.1     82.2   7.0   1   2368        1.3
1130               115.7    40.3    11.0     84.9   9.4   0   2368        1.3
1145               119.3    42.7    11.0     87.5  11.8  -2   2368        1.3
1200               123.1    45.0    10.9     90.2  14.3  -4   2368        1.3
1215               127.2    47.2    10.9     93.0  16.7  -6   2381        1.4
1230               131.7    49.3    10.8     95.7  19.1  -9   2381        1.4
1245               136.5    51.2    10.7     98.5  21.6 -12   2381        1.4
1300               141.6    52.9    10.7    101.4  24.0 -14   2381        1.4
1315               147.1    54.5    10.6    104.4  26.4 -18   2381        1.4
1330               153.0    55.8    10.5    107.5  28.7 -21   2381        1.4
1345               159.3    56.8    10.5    110.7  31.0 -25   2381        1.4
1400            E  165.8    57.6    10.4    114.0  33.3 -29   2393        1.4
1415            E  172.6    58.1    10.4    117.4  35.5 -32   2393        1.4
1430            E  179.4    58.2    10.3    121.1  37.6 -36   2393        1.4
1445            E  186.3    58.0    10.2    124.9  39.7 -39   2393        1.4
1500            E  193.0    57.5    10.2    128.9  41.6 -42   2393        1.4
```

Note that an “E” begins to appear in the “W” (for activity window) column after 1345 UTC. This signifies that the moon is in the “European Window” (within two hours of moonset in Germany when the moon has a northern, or positive, declination). Similarly, for IARU Region 2 stations, the “Asian Window” is defined as the time period 2 hours after moonrise in Japan when the moon is on a northern declination, and the “North American Window” is the period in between the two. This popular convention was popularized by W6PO in the 1970’s. Similar windows are calculated and displayed for users residing in other IARU regions.

Also notice that the polarity difference in degrees between the two stations is shown in the POL column. This polarity value is simply calculated from geometric considerations, and does not assure any particular electromagnetic polarity of the actual signals since they are also subject to “Faraday Rotation” as they travel through Earth’s ionosphere.

The sample below shows some typical lunar position output for the same two stations during a time of New Moon. When the moon’s Right Ascension is within approximately 6.5 degrees of the sun’s the program considers it to be in a “New Moon” position, and indicates this by printing “NM” under the NOTES column. Since many 6m EME contacts can still be made even during new moon periods – especially during periods of low solar activity - in Version 3, the moon coordinates are still shown even during new moon periods:

```
SEP 29,2008    41 ° 36' 15" N       MOON POSITION          RANGE:   389,433 KM
MONDAY         71 ° 32' 30" W (PREPARED BY GJTRACKER V3.0)  P +9 DAYS  15.34'SD
JD: 2454738.5
DX: 3,407.8 KM   (W1JJ in FN41fo)       (W7GJ in DN27ub)    APPROX  50   MHZ DB
UTC    NOTES    W AZIMUTH   ELEV    DEC   AZIMUTH ELEV POL  SKY °K  DEGRADATION
====  ========  = =======  ======  =====  ======= ==== ===  ======  ===========
1415  NM          136.8    29.7    -9.0   103.0   0.7 -11   5426       3.8
1430  NM          140.5    31.5    -9.0   105.8   3.1 -13   5444       3.8
1445  NM          144.4    33.1    -9.1   108.6   5.4 -14   5444       3.8
1500  NM          148.4    34.6    -9.1   111.4   7.7 -16   5444       3.8
1515  NM          152.6    35.9    -9.2   114.2  10.0 -18   5444       3.8
1530  NM          156.9    37.0    -9.2   117.2  12.2 -20   5444       3.8
1545  NM          161.3    37.9    -9.3   120.2  14.3 -22   5444       3.8
```

Similarly, when the moon is within 6.5 degrees of having a Right Ascension opposite from the sun, it is considered to be in the “Full Moon” position. At those times, “FM” is printed in the NOTES column:

```
OCT 15,2008    41 ° 36' 15" N       MOON POSITION          RANGE:   365,986 KM
WEDNESDAY      71 ° 32' 30" W  (PREPARED BY GJTRACKER)      A +10 DAYS 16.33'SD
JD: 2454754.5  W1JJ NOTES:  ,RI,Mick,,50: 4x 9el  1500W
DX: 3,407.8 KM   (W1JJ in FN41fo)       (W7GJ in DN27ub)    APPROX  50   MHZ DB
UTC    NOTES    W AZIMUTH   ELEV    DEC   AZIMUTH ELEV POL  SKY °K  DEGRADATION
====  ========  = =======  ======  =====  ======= ==== ===  ======  ===========
0215        FM    120.8    48.1    14.3    88.4  17.2  -3   3723       2.5
0230        FM    124.9    50.4    14.3    91.0  19.8  -5   3723       2.5
0245        FM    129.4    52.7    14.4    93.6  22.3  -8   3736       2.5
0300        FM    134.2    54.8    14.5    96.3  24.8 -11   3736       2.5
0315        FM    139.5    56.7    14.5    99.1  27.3 -13   3736       2.5
0330        FM    145.3    58.4    14.6   102.0  29.8 -17   3736       2.5
0345        FM    151.6    59.9    14.6   104.9  32.3 -21   3748       2.5
0400        FM    158.4    61.1    14.7   108.0  34.7 -25   3748       2.5
0415        FM    165.6    62.1    14.8   111.2  37.1 -29   3748       2.5
0430        FM    173.2    62.6    14.8   114.6  39.4 -34   3748       2.5
0445        FM  E 180.9    62.8    14.9   118.2  41.7 -39   3748       2.5
0500        FM  E 188.7    62.6    14.9   121.9  43.9 -43   3748       2.5
0515        FM  E 196.2    62.1    15.0   125.9  46.0 -47   3761       2.5
```

REAL TIME MODE OUTPUT FILE

The text file GJAZEL.dat is updated every minute with UTC, azimuth, elevation and name of the celestial object being tracked, followed by the Greenwich Hour Angle and Declination. The above quantities are in degrees, and all the data are separated by commas. The file is updated every 60 seconds when operating in the REAL TIME mode. And example of the format is as shown below:

```
20:12:00,145.0, 18.0,Moon,255.1,-24.0
```

Beginning in Version 2.0.9, the GHA and Declination data displayed have been adjusted to include corrections for viewing the moon from the surface of the earth, rather than geocentric data.

REFERENCES

The following sources were used for the primary tracking algorithms:

1. Almanac For Computers, Nautical Almanac Office, U. S. Naval Observatory, Washington, DC, USA, 20390 (for Julian Date, Greenwich Hour Angle, azimuth, elevation, Greenwich Apparent Siderial Time, and lunar semidiameter).

2. Low-Precision Formulae for Planetary Positions, T.C. Van Flandern and K.F.Pulkkinen, The Astrophysical Journal Supplement Series, American Astronomical Society, volume 41 : pp 391-411, November 1979 (for distance, right ascension and declination of the moon and sun)."

3. Explanatory Supplement to the Astronomical Ephemeris and the American Ephemeris and Nautical Almanac, Nautical Almanac Offices of UK & USA; and Spherical Astronomy by Woolard & Clemence, Academic Press, 1966 (for geocentric parallax corrections).

4. Topocentric correction factors for RA, DEC and GHA were obtained from http://stjarnhimlen.se/comp/tutorial.html#9

EXPECTED ACCURACY: Calculations used in this program are valid through year 2100 without any updates or corrections to the program. Calculated positions are within .5 degree and lunar distance is typically within 10 km. Elevations near the horizon no longer are corrected for visual or radio bending effects.