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# TrakBox Software Reference Manual

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# OVERVIEW

TrakBox communicates with you via (a) front panel switches and an LCD display (standalone mode) or (b) a terminal or computer connected to the serial port (terminal mode).

The TrakBox terminal mode interface is menu-driven. The various menus will be described and supported with examples. We recommend that you connect TrakBox to your computer or terminal and walk through the menus with this manual as your guide. The operation of the unit will become clear, and most of your questions answered, if you use this approach.

Once you are familiar with TrakBox, you may interface it to your antenna rotators with confidence.

Information for this manual was provided by JA6FTL, JG6MCG and the JAMSAT organization. It was expanded and edited into its present form by Lyle Johnson, WA7GXD.

# STARTUP

At power on startup, the battery-backed RAM will be tested with a checksum. If a checksum error is detected, the system will give the following warning message indicating that the configured values may be lost:

**Data in RAM was lost !! Set default parameter !**

After the RAM is tested, the working mode is automatically selected according to the front panel satellite selector switch (or potentiometer) position. If the satellite selection is in position 0, TrakBox starts in terminal mode. Any position other than 0 means standalone mode. In standalone mode, TrakBox will begin tracking the selected satellite using its internally stored keplerian element database. In either mode, the calculated results will be displayed on the LCD panel and sent to the serial communication port.

# TERMINAL MODE

**NOTE:** Set your terminal or computer to 9600 bps, 8 data bits, no parity and either 1 or 2 stop bits in order to use TrakBox. The serial port data rate may be altered (see Section 4). If you wish the TrakBox to power-on at 1200 bps, ground CN9 pin 8. This feature is provided for using the TrakBox remotely with a telephone modem.

In terminal mode, TrakBox will sign on and present the main menu.

```

*****
*           TrakBox  8052  v3.10a           *
*   (C) JAMSAT/JA6FTL  Jan.10 1994       *
*****

----- MAIN MENU -----

1. Realtime Tracking.
2. Display Schedule.
3. Update Satellite Elements.
4. Update Station Elements.
5. Update Realtime Clock.
6. Configuration.
7. Host mode.
8. Direct Antenna control.

Select [1-8,S,M]:_

```

These menu selections are explained below.

## 1. Realtime Tracking

This selection will display a list of satellites assigned from an uploaded keplerian element (kepele) database (see menus 3-2 and 3-3, below). Up to fifteen (15) satellites may be assigned. The asterisk (\*) mark indicates the satellite last selected. Enter the number corresponding to the satellite you wish to track, or simply press the <Enter> key to select the marked satellite.

```

*** Tracking object satellite ***
1.AO-10      2. A-13S      3. U-11      4. A-16
5. L-19      6. F-20       7.*A-21     8. W-18
9. U-22A     10. U-22B     11. K-23A   12. K-23B
13. R-10/11  14. R-12/13  15. U-14
Select:1 <ENTER>

```

TrakBox will now go to the realtime tracking display (Refer to Figure 1).

**Azimuth** and **Elevation** are to the satellite from your station location. **Range** is the straight line distance between the satellite and your station. Altitude is in kilometers above the earth's surface (assumes a smooth earth). **Latitude** and **Longitude** indicate the sub-satellite point on the earth. **Phase** represents the position of the satellite in its present orbit, expressed in parts-per-256 -- that is, Phase 0 is the beginning of an orbit, 128 is the middle of the orbit and 255 is the end of the orbit. **Doppler** frequency is expressed as an offset from the downlink frequency stored in the satellite's kepele table entry (explained in 3-1, below).

**Figure 1 - Realtime Tracking Display:**

```

===== Realtime Tracking [1993/07/17] =====

'E' Toggle rotor control  'Y' RTC zero adjust  'Q' Return to main menu
'+/-/0' Doppler compensation
  [Satellite: A-13S      ]
  UTC      Azim.   Elev.   Range   Alt.   Lat.   Long.   Phase   Doppler
HH:MM:SS  deg     deg    Km     Km     deg   deg    <256>   Hz
04:06:58  28.54  -33.61  22101.6  12938.7  33.1  36.3    9.0    +2226
  
```

The following menu selections are available with this display:

- E** toggles antenna control ON/OFF. Antenna control ON/OFF and satellite selection can also be made from the front panel switches.
- Q** return to main menu.
- Y** adjust the TrakBox Real Time Clock to 00 seconds.

The following three (3) commands act like RIT for the downlink frequency.

- +** compensate the CAT frequency by adding 100 Hz.
- compensate the CAT frequency by subtracting 100 Hz.
- 0** return the CAT freq to that calculated by TrakBox.

In addition, the following indicators are provided in this mode.

- \*** indicates the satellite is above -2.0 degrees elevation and is available for tracking.
- AOS** front panel LED which indicates AOS. If the Elevation angle from your station location to the satellite is -2.0 degrees or higher, the LED will blink. If the E command is issued, the blinking will stop and the LED will remain steadily illuminated so long as the satellite is at least -2.0 degrees above your local horizon.

## 2. Display Selection

This is used to select a satellite from a list of 15 in the same manner as menu 1, above. The difference is that the calculated information for the satellite will be displayed a screenfull at a time rather than in real time, and the antennas will not be controlled by TrakBox in this mode.

```

*** Tracking object satellite ***
1. AO-10      2. A-13S    3. U-11      4. A-16
5. L-19       6. F-20     7. *A-21    8. W-18
9. U-22A     10. U-22B   11. K-23A   12. K-23B
13. R-10/11  14. R-12/13 15. U-14
Select: 2 <ENTER>
  
```

TrakBox will next prompt you for a starting time to run the calculations. You may simply hit <Enter> to accept the present time, as well as to accept the defaults for the time step.

```

Example:
1993/07/17 04:08:45
Starting Day/Time ? [YY/MM/DD HH:MM:SS]
Day of the Year [T] > 564.17270 <ENTER>
Time Step
  Min [1]: 60 <ENTER>
  Sec [0]: 0 <ENTER>
  
```

TrakBox will then output a satellite position table showing the UTC date and time, followed by the Azimuth and Elevation to the satellite from your QTH, the orbit Phase and the Doppler on the satellite downlink. The time steps will in accordance with the selection made above.

After a screen of data is displayed, the following menu commands will be active:

- Q** quit and return to previous menu.
- S** scroll the display and continue calculations.

**NOTE:** Due to the limited processing power of the 8051 microprocessor, the schedule is a fairly slow-running program.

DATE	TIME	AZ/EL	Phase	Doppler
1993/07/17	15:09:03	248.6/40.4	0.0	+7575
1993/07/17	16:09:04	0.6/60.0	23.0	-9420
1993/07/17	17:09:06	46.5/35.0	45.0	-12029
1993/07/17	18:09:08	69.9/21.7	67.0	-9409
1993/07/17	19:09:10	90.2/13.8	90.0	-6166
1993/07/17	20:09:11	107.9/ 8.5	112.0	-3457
1993/07/17	21:09:13	123.6/ 2.0	134.0	-1217

--- 'Q' for abort 'S' for scroll ---

### 3. Update Satellite Elements Database.

This menu selection allows you to enter and/or update the Keplerian Element (kepele) database within TrakBox. The kepele database is used for all orbital calculations, and it should be updated on a regular basis. For very low orbiting satellites such as MIR or the Space Shuttle, updating may need to be done daily, while high altitude satellites like AO-13 might need to be updated only every few months.

```
===== UPDATE MENU =====
1. EDIT: View/Edit satellite Element by hand
2. SELECT: Select Satellite for list.
3. UPDATE: Clear database & read new Element
4. MULTI TRACK: Configure multi tracking sat

Select: _
```

#### 3-1. Edit

When you select option 1, a list of satellites in the kepele database will be presented. You may then enter the number corresponding to the entry you wish to update. Striking the <Enter> key will select the entry highlighted with an asterisk. Entering Q will return you to the previous menu.

```
Select: 1 <ENTER>
*** Select object satellite ***
1. AO-10      2. A-13S    3. U-11      4. A-16
5. L-19      6. F-20     7.*A-21     8. W-18
9. U-22A    10. U-22B   11. K-23A   12. K-23B
13. R-10/11 14. R-12/13 15. U-14

Select: 7 <ENTER>
```

Once a selection is made, the satellite data will be presented to you on a line by line basis. You may edit the line presented, or merely press <Enter> to accept the data for that line and continue with the next line.

```
===== Satellite data =====
Satellite   : A-21
Epoch Year  Y0 : 30           Y0:
Epoch Time T0 : 45.39066    T0:
Epoch Rev  K0 : 25718      K0:
Mean Anomaly M0 : 5.13450    M0:
Mean Motion N0 : 0.74509    N0:
Inclination I0 : 82.94470    I0:
Eccentricity E0 : 0.03601    E0:
Arg perigee W0 : 6.02190    W0:
R.A.A.N. O0 : 43.70580    O0:
Decay N1 : 1.010000e-06    N1:
Downlink Frq.F1 : 145.987    F1:
Offset for F1 : 0.000      F1OFFSET:
Uplink Frq.F2 : 435.016    F2:
Offset for F2 : 0.000      F2OFFSET:
Downlink mode : FM
Uplink mode : FM
Doppler correct. : Mic-click
LCD MA display : No
```

There are several items not included in AMSAT and NASA element sets, but used by TrakBox:

**F1** is the downlink frequency in MHz.  
**F1OFFSET** is the downlink correction factor in MHz for use with a down- or up-converter.

**F2** is uplink frequency in MHz.  
**F1OFFSET** is the uplink correction factor in MHz for use with a down- or up-converter.

**NOTE:** If F1 and F2 are not configured, no doppler correction will be calculated and no corrections will be issued to the radio(s).

**FM, LSB, USB and None** are the available mode selections. These are radio modes, not satellite modes.

**Doppler correction** may be by computer aided tuning (CAT) command or by "microphone click" inputs to the radio. Direct frequency control (CAT command) is supported for various radios from Icom, Kenwood and Yaesu. If "Mic click" doppler correction is selected, a direct frequency CAT command will be issued to the radio(s) once at AOS. Mic click correction may be useful when performing analog tracking of a PSK downlink.

**LCD MA Display** enables or disables the showing the satellite's mean anomaly (phase) on the TrakBox display. This is useful for satellites whose modes change with MA (such as AO-13).

#### 3-2. Select

Selecting option 2 allows you to choose which satellites (up to 15) will be available for tracking from the kepele database (which may contain up to 32 satellite entries).

The kepele database selections will be listed with a number for each entry. You simply enter the number desired, and that satellite will be placed in your selection list in the order you selected it.

```
Select: 2 <ENTER>
Are you sure ? [Y/N] ? Y
1. AO-10      2. U-11      3. R-10/11  4. A-13S
5. F-20      6. A-21      7. R-12/13  8. U-14
9. A-16      10. D-17     11. W-18    12. L-19
13. U-22A    14. U-22B   15. K-23A   16. K-23B
17. NAA-9    18. NAA-10  19. MR      20. HBBLE
21. SRA      22. URS     23. FEJA

Select: 1 <ENTER>

Satellite (AO-10) selected as #1
```

```

1.*AO-10      2. U-11      3. R-10/11  4. A-13S
5. F-20       6. A-21       7. R-12/13  8. U-14
9. A-16       10. D-17      11. W-18    12. L-19
13. U-22A     14. U-22B     15. K-23A   16. K-23B
17. NAA-9     18. NAA-10    19. MR      20. HBBLE
21. SRA       22. URS       23. FEJA

Select: 1 <ENTER>

Satellite (A-13S) selected as #2

```

It will then echo the format, position number and datellite name from the upload. For example:

```

NASA>#0 AO-10
NASA>#1 U-11
NASA>#2 R-10/11
NASA>#3 A-13S
...
NASA>#23 FEJA

```

Other satellites may be selected up to a total of fifteen (15).

### 3-3. Update

This menu selection is used to update (or initially load) an entire kepele database. TrakBox can hold keplerian data for thirty-two (32) satellites.

The database is usually loaded by a simple ASCII file transfer from your computer to TrakBox's serial port. The ASCII file in your computer can be in the so-called "AMSAT" format (this is the format published by AMSAT and distributed on many packet BBSes) or the two-line "NASA" format.

Your computer should be set to upload a line at a time with a slight pause between lines (or set "pacing" to about 120 characters/second or slower). After transferring the file, you will need to send a "control Z" (Ctrl-Z) character to tell TrakBox that the upload is complete. If your computer file transfer program doesn't automatically append the Ctrl-Z character (most don't), you can send it once the file transfer is complete by simply pressing and holding the <CTRL> key on your computer's keyboard, then pressing and releasing the Z key, then releasing the <CTRL> key.

TrakBox will respond with AMSAT>#1 AMSAT>#2 ... or NASA>#1 NASA>#2...

You must choose between AMSAT and NASA formats at the time of the upload.

```

Stored data in memory will be lost.
Are you sure ? [Y/N] ? Y <ENTER>
File format NASA/AMSAT (N/A) : N

Upload Kepeledata file. (EOF:ctrl+Z)

```

(TrakBox will echo the data back to the computer as it is received.)

After loading up to 32 satellites, TrakBox will prompt for a file containing the frequency and mode information needed for doppler correction and automatic radio tuning.

If you have no file, enter a Ctrl-Z; otherwise, upload an ASCII file (using your favorite text editor) in the following format:

- 1) Satellite name exactly as it appears in the AMSAT or NASA format data. This data is "case sensitive" so if you call a satellite ao-13, this file must call it ao-13 and not AO-13.
- 2) Downlink frequency in MHz.
- 3) Uplink frequency in MHz.
- 4) Downlink mode (usb, lsb, fm or none).
- 5) Uplink mode (usb, lsb, fm or none).
- 6) Doppler mode (cat or mic).
- 7) Phase display on LCD (ma or no)

These seven fields are all required. Each field is separated by a <space> character, and all seven fields must be on a single line. The line must be terminated with a <CR>.

**NOTE:** The uplink and downlink modes are radio modes (USB, LSB, FM, or none), not satellite modes (mode A, mode K, etc.).

The frequency entries may have an offset included. This is useful if you are using a down-converter for receiving Mode-S on your 2-meter receiver, for example. TrakBox will use the actual frequency for computing doppler shift, but output the actual received frequency to directly tune the radio using CAT. In the example below, the AO-13S entry, the actual frequency sent from the satellite is 2400.730 MHz. The down-converter oscillator frequency is 2256 MHz, and is subtracted from the received frequency to yield the 2-meter frequency of 144.700 Mhz which is then tuned by the CAT output from the TrakBox to the radio.

If you are going use the multiple tracking mode, only the first five satellites will be multi-tracked.

Here is a sample data file. 435.000 is a dummy value used for "uplink" to DO-17 and WO-18 since all entries must be present on each line.

```

UO-22A 435.120 145.900 fm fm cat no
UO-22B 435.120 145.975 fm fm cat no
KO-23A 435.176 145.850 fm fm cat no
AO-21 145.987 435.016 fm fm mic no
AO-13B 145.900 435.500 usb lsb mic ma
AO-16 437.025 145.940 usb fm mic no
DO-17 145.825 435.000 fm none cat no
WO-18 435.075 145.000 usb none cat no
LO-19 437.125 145.840 usb fm mic no
FO-20A 435.910 145.850 usb fm cat no
FO-20B 435.910 145.870 usb fm cat no
AO-13L 435.850 144.500 usb lsb mic ma
AO-13S 2400.730/-2256.000 435.620 usb lsb mic ma
AO-10 145.900 435.100 usb lsb mic ma
STS-47 145.550 435.000 fm fm cat no
KO-23B 435.176 145.900 fm fm cat no

```

You must end this file transfer to TrakBox with a <Ctrl-Z>

#### Example:

Upload freq/mode data file. (EOF:ctrl+Z)

If you used the sample file shown above, Trakbox would echo the data file back to the computer. After receipt of the Ctrl-Z, it would acknowledge like this:

```

Satellite ( U-22B) updated and selected as # 1
Satellite ( K-23A) updated and selected as # 2
Satellite ( A-21) updated and selected as # 3
Satellite ( A-16) updated and selected as # 4
Satellite ( D-17) updated and selected as # 5
Satellite ( L-19) updated and selected as # 6
Satellite ( A-13S) updated and selected as # 7
Satellite ( K-23B) updated and selected as # 8

```

The newly loaded or updated kepele database will now be displayed and you will automatically enter Menu 3, above.

### 3-4. Multi Track

Use this option to tell the TrakBox to always calculate the orbital elements for the specified satellites simultaneously. This allows you to operate the first satellite of the group when it reaches your QTH's AOS. There are "normal" and "priority" sub-modes to multi-tracking, explained later in Section M of this manual.

Select: 4 <ENTER>

How many satellites configure for multi tracking mode ? (2-5) 3 <ENTER>

The number of satellites you select will be used. If you select 3, for example, the first three satellites you entered in Menu 3.2 (above) will be configured for multi-tracking.

## 4. Update Station Element

Use this option to tell TrakBox about your station. You will typically use your station callsign as your station name. Latitudes and Longitudes are entered in decimal degrees, not degrees, minutes and seconds. Use positive numbers for North Latitudes and East Longitudes, and negative numbers for South Latitudes and West Longitudes. Antenna height information is in meters above sea level, **not your antenna tower height above local ground**. Rotor start is used to indicate the "end of rotation" of your azimuth rotator. This is either South or North. The COM port baud rate selection supports 1200, 2400, 4800 or 9600 bps, with 9600 as the default.

The example below shows a typical entry scenario:

```

===== Station Element =====
Callsign: NOCALL      WA7GXD <ENTER>
Latitude: +27.391    32.259 <ENTER>
Longitude: +128.657  -110.778 <ENTER>
Antenna height: 50.000  842 <ENTER>
Rotor start (S/N): South  S <ENTER>
COM port baud: 9600    9600 <ENTER>

```

## 5. Update Realtime Clock

This menu selection is used to set (or reset) the TrakBox battery-backed real time clock.

There are initially three (3) submenu choices:

- Y** reset the seconds to zero and return to the previous menu.
- Q** return to the previous menu.
- <Enter>** fully set the real time clock.

Example:

```

Enter 'Y' for zero sec. adjustment
Enter 'Q' for exit
Enter 'Ret' for Real Time Clock set
Present Time:UTC 1991/12/15 05:13:04
<Enter>

```

The next menu allows you to set the real time clock. Enter the last two digits of the year, then the month in a two-digit format (January is 01, December is 12) and the day of the month as a two-digit number. Enter a space and then the hours, minutes and seconds all as two digit numbers.

Date information is separated by a slant bar (/); time information is separated by a colon (:). After you are finished, you will be prompted to press the <Enter> key when the time you have set occurs.

Time should be kept in UTC.

Example:

```
Set realtime Clock.
Present Time: UTC 1991/12/15 05:13:04
Enter with format [YY/MM/DD HH:MM:SS]
Set time: 93/07/17 03:03:15 <Enter>

ENTER when ready. <Enter>
```

## 6. Configuration

This selection is used to set all the rest of the configuration information needed by TrakBox. When you make this selection, TrakBox will present you with a rather lengthy menu of items to configure.

In addition, the following command is available:

**Q** return to the previous menu.

Example:

```
Select: 6 <ENTER>

===== Configuration Menu =====
0. Display all configured value
1. Calibration of antenna span value
2. Set ADC span value
3. Set Dead Band and Skew value
4. Set Antenna Parking and Limit position
5. Monitor ADC value & Antenna position
6. Direct antenna control
7. Radio CAT port configuration
8. Mic click configuration
9. Set default parameter

Select: _
```

These will now be explained.

### 6-0. Display

This choice causes TrakBox to display its present configuration.

The following command is available when selecting this option:

**Q** return to the previous menu.

```
Select: 0 <ENTER>
Callsign:N50IN Lat:32.3 Long:-110.8 Hgt:0.0
ADC span value AZ: 3 - 837 EL: 1 - 460
Dead band AZ:3.0 EL:1.0
Skew AZ:0.0 EL:0.0
Antenna parking Off
Rotator limit Off
CAT Rig KENWOOD AOS
Step control ADC value Center:550 Reff:560
Frequency step 100 Hz
Rotor start South
COM port 9600 Baud 8-N-1

Press any key to continue
```

### 6-1. Calibration of Antenna Span Value

This option enables TrakBox to calibrate itself to the rotator(s) you are using.

**WARNING!** Be very careful when specifying the end of rotation (0/360 for azimuth, 0/90 for elevation) as well as dead band. If you specify a value that the rotator will not reach, or if the voltage drifts with time, the TrakBox may command the rotator continuously. If the rotator does not have working limit switches to remove the power, you may damage ("**smoke**") your rotator or rotator power supply!

TrakBox will ask you to rotate your Azimuth antenna fully counter-clockwise (CCW) and your Elevation to the horizon (0 degrees). After you do this and confirm it, TrakBox will ask you to set your Azimuth rotator to the fully clockwise (CW) position and your elevation rotator to the maximum value (90 degrees).

**NOTE:** Setting the Elevation to maximum means to set it pointing straight up, or 90 degrees. It does not mean to extend the rotator completely over to the opposite horizon (180 degrees)!

The maximum span value that TrakBox can measure occurs with +5 volts DC at one extreme of the rotator position and 0 volts at the other extreme. In this case, you will have a measurement resolution of about 0.35 degrees in Azimuth and 0.18 degrees in Elevation.

In addition, the following command is available under this option:

**Q** return to the previous menu.

```
Select: 1 <ENTER>
ADC span value AZ:0003-0837 EL:0001-0460

Rotate the antenna to fully CCW and
Elevation minimum position [Y/N] ? Y
Rotate the antenna to fully CW and
Elevation maximum position [Y/N] ? Y
```

## 6-2. Set ADC span value

This option allows you to manually calibrate TrakBox to the rotator(s) you are using.

**WARNING!** Be very careful when specifying the end of rotation (0/360 for azimuth, 0/90 for elevation) as well as dead band. If you specify a value that the rotator will not reach, or if the voltage drifts with time, the TrakBox may command the rotator continuously. If the rotator does not have working limit switches to remove the power, you may damage ("**smoke**") your rotator or rotator power supply!

TrakBox will ask you for the ADC reading corresponding to Azimuth at the minimum, or fully counter-clockwise (CCW) and maximum, or fully clockwise (CW) positions. It will then ask you for the ADC reading corresponding to minimum Elevation (0 degrees) and maximum (90 degree) positions.

**NOTE:** Setting the Elevation to maximum means to set it pointing straight up, or 90 degrees. It does not mean to extend the rotator completely over to the opposite horizon (180 degrees)!

The maximum span value that TrakBox can measure occurs with +5 volts DC at one extreme of the rotator position and 0 volts at the other extreme. In this case, you will have a measurement resolution of about 0.35 degrees in Azimuth and 0.18 degrees in Elevation.

The ADC measures voltages in 10 bits, so +5 volts corresponds to a reading of 1023, and 0 volts corresponds to a reading of 0. The actual ADC values corresponding to your rotator(s) can be found by performing menu selection 6-5, below.

In addition, the following command is available under this option:

**Q** return to the previous menu.

Example:

```
Select: 2 <ENTER>
ADC span value   AZ: 008 - 0492
AZ minimum value ? : 9 <ENTER>
AZ maximum value ? : 887 <ENTER>

ADC span value   EL: 002 - 0424
EL minimum value ? : 3 <ENTER>
EL maximum value ? : 465 <ENTER>
```

## 6-3. Set Dead Band and Skew Value

This option allows you to enter the number of ADC counts that will be ignored by TrakBox when pointing your antenna(s). This is necessary to avoid excessive rotator wear caused by "hunting". You should also take into account your antenna beamwidth. For example, it is not necessary to point the antennas to 1 degree of accuracy when your antenna pattern is 20 degrees wide!

**WARNING!** Be very careful when specifying the end of rotation (0/360 for azimuth, 0/90 for elevation) as well as dead band. If you specify a value that the rotator will not reach, or if the voltage drifts with time, the TrakBox may command the rotator continuously. If the rotator does not have working limit switches to remove the power, you may damage ("**smoke**") your rotator or rotator power supply!

TrakBox uses a default dead band of 3 counts for Azimuth and 1 count for Elevation.

This option also allows you to set the skew value for the ADC for both Azimuth and Elevation. Skew is a measure of the mechanical offset between your indicated antenna position and your actual antenna position. This might be caused over time by wind, ice or other factors. Use of skew reduces the number of trips you must make up your tower to re-align your antennas to your rotators.

Skew is added to the ADC reading and is accepted in both positive and negative values.

In addition, the following command is available under this option:

**Q** return to the previous menu.

Example:

```
Select: 3 <ENTER>

Azimuth   Dead Band : 3.0   5 <ENTER>
Elevation Dead Band : 1.0   3 <ENTER>

Azimuth   Skew value : 0.0   <ENTER>
Elevation Skew value : 0.0   <ENTER>
```



#### **6-4. Set Antenna Parking and Limit Position**

This option allows you to set a parking position for your antenna as well as specify operational limits. You may wish to do this to minimize mechanical strain on your system when not in use or point to the most common general AOS position for your favorite satellite (parking). Or, you may need to limit the motion of your antenna to prevent it from hitting an obstruction at an extreme elevation (limit).

In addition, the following command is available under this option:

Q return to the previous menu.

Example:

```
Select: 4 <ENTER>
Set Antenna Parking position ? [Y/N] Y
Azimuth Parking value : 0.0 90 <ENTER>
Elevation Parking value : 0.0 45 <ENTER>
Set Antenna rotation limit ? [Y/N] Y
Azimuth minmum value : 0.0 <ENTER>
Azimuth maximum value : 360.0 340 <ENTER>
Elevation minmum value : 0.0 <ENTER>
Elevation maximum value : 90.0 60 <ENTER>
```

#### **6-5. Monitor Antenna Position and ADC Values**

This selection allows you to read the present antenna position as determined by TrakBox. It can be used to gather ADC values for manual setting of ADC span (see 6-2, above) if you don't want to let TrakBox do this for you automatically (see 6-1, above).

In addition, the following command is available under this option:

Q return to the previous menu.

Example:

```
Select: 5 <ENTER>
=== ADC value & Antenna position ===
AZ= 519 / 32.8deg EL= 462 / 90.0deg.
```

#### **6-6. Direct Antenna Position**

This selection allows you to manually enter ADC values for TrakBox to point your antenna(s) to.

In addition, the following command is available under this option:

Q return to the previous menu.

Example:

```
Select: 6 <ENTER>
```

A sub-menu will appear. Three selections are offered; they will be listed in order.

```
1.Direct rotor control from key board.
2.Enter direction value.
3.Preset Control.
Select[1-3,Q]:
```

##### **6.6.1 - Direct Antenna Position: Keyboard Control**

Direct control allows you to command the antenna system left, right, up, down or stop by using numeric keys on your keyboard. The display will be continually updated. When you have the antennas pointed in the direction you wish, press <5> to stop motion then hit <ENTER> to exit this function.

Example:

```
Select[1-3,Q]: 1 <ENTER>
Left(4),Right(6),Up(8),Dwn(2),Stop(5)or Ret
AZ= 926 / 199.7deg EL= 431 / 84.0deg.
```

##### **6.6.2 - Direct Antenna Position: Enter Value**

This option will display the current Azimuth, allow you to enter a desired value, then repeat for Elevation. Once the desired values are entered, TrakBox will point your antennas to the position entered.

```
Select[1-3,Q]: 2 <ENTER>
Azimuth: 220.3 210 <ENTER>
Elevation: 84.0 20 <ENTER>
```

A "live" display of the antenna position as it is being moved will be displayed.

```
AZ= 967 / 216.5deg EL= 400 / 77.9deg.
```

### 6.6.3 - Direct Antenna Position: Preset Control

Up to five (5) preset combinations of Azimuth and Elevation values may be stored in the TrakBox internal memory. When you select "Preset Control", a list of the five presets will be displayed. You merely type the number corresponding to the preset you desire and Trakbox will point the antennas to that setting, with a display of the current position.

To load the presets, select the "S" option, with "Q" to quit.

```
Select[1-3,Q]: 3 <ENTER>
1:0.0/0.0 2:0.0/0.0 3:0.0/0.0 4:0.0/0.0 5:0.0/0.0
Select[1-5,S,Q]: s <ENTER>
Preset position 1  Az: 0.0  125 <ENTER>
                   El: 0.0  15  <ENTER>
Preset position 2  Az: 0.0  90  <ENTER>
                   El: 0.0  22  <ENTER>
Preset position 3  Az: 0.0   0  <ENTER>
                   El: 0.0  45  <ENTER>
Preset position 4  Az: 0.0 270 <ENTER>
                   El: 0.0  10  <ENTER>
Preset position 5  Az: 0.0 165 <ENTER>
                   El: 0.0   0  <ENTER>
1:125.0/15.0 2:90.0/22.0 3:0.0/45.0
                               4:270.0/10.0 5:165.0/0.0
Select[1-5,S,Q]:
```

### 6-7. Radio Port Configuration

This menu item allows you to configure TrakBox for the radio(s) you are using. TrakBox supports direct frequency control (CAT) for various models of Icom, Kenwood and Yaesu equipment. It assumes you are using the same product line for both transmit and receive -- for example, you can't control a Kenwood TS-711 2-meter radio and an Icom 475 70-cm radio at the same time with TrakBox.

#### Icom

If you select Icom, there will be a second selection line for you to enter the CI-V address. The factory defaults for various Icom radios are:

IC-275:10H IC-375/475:14H IC-970:2EH  
IC-271:20H IC-371/471:22H

**NOTE:** For the 271/371/471 you must use the Icom UX-14 option.

You can change a radio's address value with the DipSwitch inside the radio. The TrakBox default address is "00" which is a "broadcast" address for Icom radios. Any CI-V equipped Icom rig will accept this value. However, if you are using a pair of radios, say an IC-275 and an IC-475, you will want to be sure and set their addresses so TrakBox can control both uplink and downlink doppler correction.

The Icom CAT port configuration is fixed at 1200 bps, 8 data bits, no parity, 2 stop bits. This rate is automatically selected when you choose Icom from the menu.

The CAT port can either drive an RS-232 level converter or it can be connected at TTL levels to the Icom CAT ports directly. See the TrakBox Hardware/Assembly manual for connection information.

#### Kenwood

The Kenwood CAT interface will work at either RS-232 levels or directly at TTL without an RS-232 converter. See the TrakBox Hardware/Assembly Manual for connection information.

The Kenwood port has been tested with the TS-790 radio and is believed to work with the TS-711 and TS-811 radios as well.

The Kenwood CAT port configuration is fixed at 4800 bps, 8 data bits, no parity, 2 stop bits. This rate is automatically set when you choose Kenwood from the menu.

#### Yaesu

The Yaesu CAT interface will work at either RS-232 levels or directly at TTL without an RS-232 converter. See the TrakBox Hardware/Assembly Manual for connection information.

The Yaesu port has been tested with the FT-736 radio.

The Yaesu CAT port configuration is fixed at 4800 bps, 8 data bits, no parity, 2 stop bits. This rate is automatically used when you select Yaesu from the menu.

If you are using the Yaesu configuration with an FT-736, you will additionally be asked if the FM filter has been changed for a wider one (for UO-22 use).

#### All Radios

You will be asked to enable uplink and downlink correction independently. This allows uplink, downlink, both or neither to be sent to your radio. In addition, downlink correction will offer the choice of Reverse in case you are using a downconverter with a high-side local oscillator.

There will also be a choice to select whether CAT commands will be issued for a full orbit, or only under conditions when the satellite is visible or nearly visible (AOS). Select F for full orbit, and A for AOS only.

In addition, the following command is available under this option:

**Q** return to the previous menu.

Example:

```
Select: 7
CAT Rig KENWOOD, YAESU, ICOM [K/Y/I] ? i
Enter destination Address for RX (00) 14<ENTER>
Enter destination Address for TX (10) 10<ENTER>

Uplink Doppler correction ? [Y/N] Y
Downlink Doppler correction ? [Y/N/R] Y
Select Full orbit or AOS CAT control ? [F/A] a
```

### 6-8. Mic Click Configuration

This menu is used to configure the ADC value used for mic click control. TrakBox uses a closed loop measurement system for mic click doppler correction. A DC error voltage from the radio's FM discriminator (for 9600 bps operation as on UO-22) or PSK modem (for 1200 bps operation as on FO-20 or AO-16) is fed to TrakBox input ADC3 (see the TrakBox Hardware/Assembly manual for connection information). If the measured error voltage exceeds the span value defined in this menu, an UP or a DOWN pulse will be generated. The maximum ADC input voltage must be less than +5.0V (this is an ADC count of 1023).

You will be asked to specify the size of frequency step the radio performs. You will also be given the option to have TrakBox pre-tune your radio and pre-correct for anticipated AOS doppler via the mic-click interface.

In addition, the following command is available under this option:

**Q** return to the previous menu.

```
Select: 8
Set new value or Measure ADC value ? [S/M] s
Modem locked center ADC value: 550 525 <ENTER>
Reference ADC value : 560 500 <ENTER>

Enter Step Frequency [Hz]: 50 <ENTER>
Frequency set CAT command at AOS ? [Y/N] Y
Automatic up pulse generation at AOS ? [Y/N] Y
Polarity of step pulse, Normal/Reverse? [N/R] N
```

### 6-9. Set Default Parameter

This menu option is used to reset all configuration parameters to the EPROM defaults. If this is done, all parameters in RAM will be reset to their default values and the kepele database will be lost. A beep tone will be sent to the computer and a prompt to allow you to load a configuration file will be given.

In addition, the following command is available under this option:

**Q** return to the previous menu.

```
Select: 9 <ENTER>
Stored data in memory will be lost.
Are you sure ? [Y/N] ? Y
Configure your station elements by
uploading data file ? [Y/N] Y
```

Any answer other than Y will return you to the previous menu. A Y response will generate a request to load a station configuration file which must end with a <Ctrl-Z> (see menu 3-3, above, for an explanation of uploading files into TrakBox).

```
Upload Station info data file (EOF:ctrl-Z)
```

The station information file must be an ASCII file with the following format:

```
Line 1 Callsign Latitude Longitude Height rotor_zero
Line 2 azimuth_mini azimuth_max elevation_mini
elevation_max
Line 3 azimuth_deadband elevation_deadband az_skew
el_skew
Line 4 CAT_rig F/A ICOM_rx_address ICOM_tx_address
Line 5 Antenna_park_ON/OFF park_Az park_El
Limit_ON/OFF Az_min Az_max El_min El_max
```

Items in each line are separated by a <space> or <tab> character. Each line must end with a <CR>. Line numbers must be the first character in each line, and the lines must be in order.

**NOTE!** The values in lines 2, 3 and 5 are in terms of ADC counts, not degrees! The ON/ODD choices in line 5 are specified by using a "1" (on) or "0" (off).

A sample file follows:

```
1 WA7GXD 32.259 -110.778 842 S
2 3 1017 5 454
3 5 3 0 0
4 ICOM A 10 14
5 1 90 0 1 270 90 0 45
```

**NOTE:** After uploading the configuration file, verify the information by menu selection 6-0, above

## 7. Host Mode

Trakbox supports a host mode to allow other programs to directly interact with it without having to respond to menus. This makes it easy for a program running on a PC, for example, to directly control a rig's frequency and point the antennas without having another antenna control interface or knowing the details of various radio manufacturer's CAT protocols. Further control of the radio is allowed beyond those commands (frequency and mode) that TrakBox knows. The Host command set is:

<u>Command</u>	<u>Argument</u>	<u>Example</u>
AZxxx ELxxx	Angles in degrees	AZ220 EL45
MUxxx	Uplink radio mode	MUFM
MDxxx	Downlink radio mode	MDUSB
FUxxxxxxx	Uplink frequency to 10 Hz	FU14595000
FDxxxxxxx	Downlink frequency to 10 Hz	FD43590000
Sxxx	Send "string" to radio	STX;
Q	(none) - quit to main menu	
?	(none) - help for commands	
?A	(none) - returns present antenna Az/El value	

On entry, Trakbox announces it is in host mode, supplies a prompt line of the commands it knows, and then issues the prompt:

```
TrakBox >>
```

After Trakbox executes a host mode command, it returns the prompt to tell the program it is ready for another command. All commands must end with a <CR>.

```
Select [1-8,S,M]: 7 <ENTER>
TrakBox host mode.

Command:MUxxx,MDxxx,FUxxx,FDxxx,AZxxx_ELxx,Sxxx,Q,?A,?
TrakBox>>
```

## S. Single Tracking Mode

This selection allows you to track a single satellite. The 15 satellites in the TrakBox active kepele database are displayed, with an asterisk (\*) by the active one. You then enter the number corresponding to the satellite you wish to track, or simply press <ENTER> if the one marked with an asterisk is the one you want.

As always, press "Q" to return to the main menu.

## M. Multiple Tracking Mode

TrakBox support two multi-tracking modes.

This selection prompts you for the satellite you want displayed on the TrakBox LCD screen. TrakBox then displays the Az/El values for the (up to) five satellites you desire. The number of satellites is specified by you under Menu 3 Selection 4 (see section 3.4).

If any of the satellites are AOS, TrakBox will immediately switch to single tracking mode for that satellite. If more than one is AOS, the one with the lowest database entry number will be selected.

If Priority mode is then selected, the highest priority satellite (the one with the lowest database number) that is AOS will be selected. This will be evaluated every second, so if a higher priority satellite becomes AOS, TrakBox will automatically drop the satellite you are presently tracking and track the higher priority one. If an even higher priority satellite comes into view, TrakBox will slew to it.

The active satellite is marked with an "!" when priority mode is not selected and an "&" when it is, rather than the "\*" of single track mode.

## STANDALONE MODE

Once the kepele database is loaded, the clock is set and your station information is entered, TrakBox is ready to work in standalone mode. No terminal is necessary in this mode until you want (or need) to change the settings of the real time clock, update the kepele database or change your system configuration.

Simply set the satellite selector to a position between 1 and 15 (position 0 selects terminal mode) and TrakBox will immediately begin tracking the selected satellite.

The AOS LED will blink when the satellite is within range and the track switch is off. It will illuminate steadily when the satellite is in range and the track switch is on.

The LCD display will indicate the UTC time and the selected satellite on the top line, and Azimuth and Elevation to the satellite from your station on the second line. The format of the LCD display is:

```
07:34:54 UO-14
Az 146.7El -62.8
```

In this example, the time 7:34 AM (a 24-hour time format is used by TrakBox). UO-14 is the satellite being tracked. The present Azimuth is 146.7 degrees, or roughly SSE. The present elevation is -62.8 degrees -- the satellite is far below the horizon and the antennas will not be pointed towards it.

If you have enabled the "ma" feature, the lower line in the display will read something like:

```
A110 E20 P119.2
```

where P is the "phase" varying from 0 to 255.

If you place the selection switch to position 0 (terminal) then back to your desired satellite, you will toggle TrakBox between the Single and Multiple track modes if you have Multiple tracking enabled.