USER's GUIDE FOR SBASE

A Data Base Program for Satellites

by

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1.0 INTRODUCTION

SBASE creates and maintains a file containing Keplerian and EQX data for up to 20 different satellites. The program has the following features, which can be selected from a menu -

1 Input Keplers from keyboard
2 Input EQX from keyboard
3 Input Two-line Keplers from file
4 Input Keplers from UOSAT DCE
5 Display Kepler
6 Display EQX
7 Generate EQX from Kepler
8 Update SATFOOT
9 Change data base
10 Change name of satellite
11 Delete satellite

SBASE is not a tracking program. However many tracking programs can be modified to use the data base. The disc contains the following examples of its application -

ALLSAT	PLAN10 with a simple display
SATORB2	A useful tracking program from the Public Domain
CORBIT	An EQX program based on ASCOT.

The programs KPROG and EPROG are DIY frameworks for creating new applications. They include procedures 'kepler_tracking_program' or 'EQX_tracking_program' may be modified to contain your favourite tracking program.

The program 'UOSAT' is also included. This is used to display, and save UOSAT telemetry or text messages on disk. This is used with menu option 6.

NB: Users whose BBC Micro is fitted with a VLSI Serial Processor (VC 2026) should use the supplied 'VLSI' program in place of 'UOSAT'. This ensures UoSAT-2 signals can be read in via the cassette port.

Computer requirements.

BBC B, 32K
BASIC 2
OS 1.2
DFS ... Acorn or Watford 1.43

2.0 GETTING TO KNOW SBASE ... a guided tour.

SBASE contains many features, so it's a good idea to try them all before using SBASE for real.

Firstly copy all the files to a blank disk. Keep the original as your master /back up. You should have the following files - SBASE, SAT, KEP, RAW, UOSAT, KPROG, EPROG, plus one or more satellite tracking programs (modified for SBASE use). If you use SATFOOT, copy it onto your user disk.

The following familiarisation exercise is suggested -

2.1 Load SBASE. Use menu options 5 and 6 to display the info already in the data base.

2.2 Now that you've had a look at the data, try using it. Exit from SBASE (menu option 0) and CHAIN one of the user programs. Just press return to get the default data base SAT. You will notice that each program comes up with the same menu, from which you select the satellite required. What happens next depends on the features of the individual program.

Its also worth trying out KPROG and EPROG. These programs are frameworks for building your own application programs. You will notice that they come up with the now familiar menu. All they do is to demonstrate that they have got the orbital data, and in the case of OSCAR 10 and 13 demonstrate the schedule.

2.3 Now go back to SBASE. Enter some Keps and EQXs from the keyboard (options 1 and 2). Use options 5 and 6 to look at the data which you have entered. When you enter the Keps try both circular and elliptical elements. You will be asked for the operating schedule and ALON ALAT for the elliptical ones. Try changing just one item in the data, by pressing return until that item comes up, and then return for all those which follow.

2.4 Use option 3 to get some data from the Two-line file KEP. When you have added one or two satellites, go back to the menu, and use option 5 to examine the values for these new satellites.

2.5 Use option 4 to get some data from the UOSAT file RAW. When you have added one or two satellites, go back to the menu, and use option 5 to examine the values for these new satellites.

2.6 Use menu option 7 to generate EQXs for these new satellites. You will be asked for a day number, which must be after the epoch day number in the Keplers. Use menu option 6 to examine the data which you have just generated.

2.7 Use Option 10 to rename one of the satellites, eg. MET-2 to OLDWX. Use option 5 to look at the modified list.

2.8 Delete a satellite in the middle of the list, with option 11. Note that next time you display the list, there will be a blank line.

2.8 If you are a SATFOOT user, use option 8 to create a modification file for one or two satellites. You need to decide which SATFOOT numbers to allocate, and you will also need to change the name eg OSCAR-9 to U1. When you have generated the file exit from SBASE, and look at the directory with *CAT. You should have a file SMOD. To examine this enter *TYPE SMOD. Follow the instructions given in the SATFOOT section to update your program.

2.9 If you have a recording of UOSAT-2 connect that old cassette to the BEEB and use the program UOSAT to create a RAW file. And then put the data into SAT file using SBASE. It saves typing those long numbers.

2.10 Use menu option 9 to change the data base, enter NEW as the name. Enter some data by options 1, or 2. Note that the program will create a new file. If you look at the contents, you will notice that only the data just entered is present.

If you've managed to get this far you should now be able to take SBASE onto the road. Good tracking!

3. OPERATING INSTRUCTIONS.

3.1 Starting SBASE

CHAIN "SBASE". The program will use the default file SAT. If SAT does not exist, then SBASE will create it, when data is to be stored.

3.2 Entering Data (menu options 1 & 2)

A list of satellites is displayed. Select a blank space for a new satellite, or one that you wish to change. You will be prompted for the data, and shown how many decimal places you really need (enter more if it makes you feel any better!). The current value stored is also shown. Just press <return> if you wish to leave that value unchanged, you will then be asked for the next one.

If you have entered Keplerian data for an elliptical orbiter eg. OSCAR-13, the program will ask for the operating schedule, and values of ALON, and ALAT. The operating schedule is specified in up to six segments. Mode is specified by one or two characters, and the mean anomaly start and finish values can be between 0 and 255.

Some mode codes have special meaning -

Z	Deletes the previous entry in the segment.
O	Mode OFF
X	DO NOT USE (for OSCAR-10)

Its up to you how you use this facility. You could use modes such as BH for mode B high gain antenna, BL for low gain, and S1, S2 for various types of mode S.

If you want to leave a segment unchanged just press return, to go on to the next segment.

Some tracking programs use ALON and ALAT to get the squint angle. The nominal values are 180 and 0 respectively. Use these if you don't have the exact values which are published in OSCAR News, on UOSAT, or OSCAR-13 PSK.

After entering the data, use the display options to check it.

3.3 Display Data (menu options 5 & 6)

The satellite is selected from a menu.

3.4 Input Two-line Keplers from file (menu option 3)

This saves you typing in the Keplers. The program scans through a file of NASSA two-line elements. It stops on each element which has a correct check-sum. You then have the option to store it in the data base file, read the next one, or return to the main menu. The default name of the Kepler file is KEP, files of other names can be used if required. Files of NASSA two-line elements can be obtained from packet radio or telephone bulletin boards.

3.5 Input Keplers from UOSAT (menu option 4)

Another option to save you typing in the Keplers. The program scans through a file of raw UOSAT data. It stops on each DCE Kepler message which has a correct check-sum. You then have the option to store it in the data base file, read the next one, or return to the main menu. The default name of the UOSAT file is DCE, file of other names can be used if required. Program UOSAT can be used for producing the files.

3.6 Generating EQX's from Keplers (menu option 7)

The program will generate the first EQX on any specified day after epoch. You select the satellite from a menu, and enter the day number, which should be in the same year as epoch. The routine takes a minute or two to generate the EQX, it uses PLAN10 routines to generate points around the orbit, and selects the one closest to the equator.

3.7 Update SATFOOT (menu item 8)

SATFOOT uses a lot of memory owing to the use of screen graphics. There is very little memory spare for adding extra routines. Folks have had problems by using too many decimals in their Keplers! To get round this problem SBASE generates a modification file, default name SMOD. This contains up to 10 lines of BASIC, numbered between 40 and 130.

The menu allows you to select a satellite by name, and set up its SATFOOT number in range 0 to 9. You can also change the name to the short form used by SATFOOT, eg U1 for OSCAR-9. When all the satellites to be modified have been selected, return to the main menu, and exit. SATFOOT is then updated in the folowing way - Copy SATFOOT onto a new disk, so that you don't spoil your original. Copy SMOD onto the same disk. Then LOAD "SATFOOT", *EXEC SMOD, SAVE "SATFOOT" The updated version of SATFOOT can now be run in the usual way.

NOTE The version of SATFOOT I use is V 1.2. It is important that any other version should use lines 40 to 130 for the Keplers for satellites 0 to 9 respectively.

3.8 Change Data Base (menu option 9)

The program uses the default name SAT for the data base file. To read data bases having other names, or to create a data base with a different name, this option can be used. Note that it does not change the name of an existing data base. To do this use *RENAME. It is sometimes convenient to keep old data by renaming eg. say to JUL87, indicating that it was correct in JULY 87.

3.9 Change name of satellite (menu option 10)

This is useful if you want to retain some old elements, for future reference, or to prevent it being automatically updated by UOSAT.

3.10 Deleting a Satellite (menu option 11).

The satellite's name is removed from the data base. All the previous data is cleared down to zero. A space will then be shown next time you get the list of satellites.

4. UOSAT DISPLAY AND STORAGE PROGRAM.

This program has evolved from Trevor Stockhill's program, published by AMSAT and UOS. This program displays, prints, and stores UOSAT data from a cassette or via a decoder. The operation of this program should be obvious once the program has been started. However instructions are available on request. Use menu option 3 to store raw data for use with SBASE.

5. BUILDING A TRACKING PROGRAM

Two frame work programs KPROG and EPROG are supplied to enable you to modify your own favourite tracking program to enable it to read orbital elements from the data base. The modification procedure which is outlined below does require some knowledge of programming and therefore is not recommended for absolute beginners. The task is made easier if you have a program development utility ROM. I recommend TOOLKIT PLUS which can be obtained from BEEBUG Ltd., of 117 Hatfield Road, St. Albans, AL1 4JS. This has an excellent screen editor, and many other useful features which enable you to move lines around, delete lines, and merge files etc.

If you are building a tracking program from scratch I recommend that you obtain the latest version of James Miller's PLAN13, which contains tried and tested routines for the orbital calculations. You can then add your own display and print routines and then KPROG.

The code in KPROG and EPROG has been numbered with a gap between lines 2000 and 10000. This is where your tracking program goes. It will then be inside a procedure called kepler_tracking_program or eqx_tracking_program. In the description which follows I will just refer to the Kepler program. The EQX procedure will be similar.

5.1 Renumber your satellite tracking program to start at 2000. Save on disk as "TEMP".

5.2 Merge TEMP and KPROG using the procedure given in the BEEB manual, or use TOOLKIT PLUS. Save the resultant program as TEMP1.

5.3 If the tracking program already provides multiple satellites, remove the READ statements which pick up the Keps from DATA lines (remove these also).

5.4 Equate the Keplerian element names used in the tracking program with those in the print statements at the start of procedure kepler_tracking_program unless they are identical. And I really mean IDENTICAL. Spelling, case, and BASIC type (ie. REAL, INTEGER .. %, STRING .. $). Eg. if your program uses A$ for satellite name, AP for argument of perigee, and RV for revolutions, then you insert the following statement after PROCget_keps -

```
A$ = sat_name$
AP = W
RV = RV%
```

5.5 Remove any mode changes from inside the procedure, to before the call to PROCkepler_tracking_program (around line 210). If you change the mode, restore to mode 7 after calling this procedure.

5.6 Replace the END statement in the tracking program by ENDPROC.

5.7 Remove any ON ERROR statements from the original tracking program.

5.8 Save the modified program.

5.9 Try running the program. You will notice that it comes up with the list of Keps and schedule demo. Once you get your program running correctly delete the print statements which give this display. Also delete the procedure 'display_schedule'.

5.10 With some programs an alternative approach may be better, particularly if there are mode changes within the tracking program.

The KPROG routines are renumbered above the tracking program, which is then modified to include calls to PROCmenu and PROCget_keps. Before the tracking program starts the code to select the data base file is inserted. This approach has been used in the demonstration program SATORB2.

Please note that the above procedure is only a rough guide to the task. Every program is different so there will probably be some debugging to do.

6. TECHNICAL DETAILS

Data is stored in a fixed format sequential file of 2340 bytes, for 20 satelites which are numbered 1 to 20.

Each satellite occupies 117 bytes.

The satellite name is a string of 8 characters which occupies 10 bytes. Shorter names are automatically padded with spaces to make up 8 characters. Each integer is stored as 5 bytes and each real as 6 bytes.

The file pointer PTR to each satellite is _

Name	(sat_no%-1)*117
Kepler data	(sat_no%-1)*117 +10
Eqx data	(sat-no%-1)*117 +68

The operating schedule is compressed into a single 4 byte integer for each segment, although segments 5 and 6 are actually stored as a real. This is because the operating schedule uses the EQX part of the file.

The bytes in the integer are -

MS	First character of mode
MS-1	Secondcharacter of mode
MS-2	From mean anon 0 .. 255
LS	To mean anom 0 .. 255

It was very convenient that MA is in these units instead of degrees!

When the schedule is read by 'get_keps' the integer is decoded into mode$, to% and from%. These are then put into an array of six (segments).

7. GENERAL INFORMATION

SBASE is given to the Public Domain for the benefit of all Radio Amateurs, and users of amateur satellites. The disk does however contain routines from PLAN10 by James Miller, and ASCOT by John Brannigan. Permission has been granted by these authors to use their routines for amateur purposes, provided their copyright is respected.

I plan to support this program for as long as possible, but cannot guarantee to do so indefinitely. An SAE at any time will get you details of any updates.

If you have any comments or queries please write (enclosing SAE if you need a reply) to

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UPDATE HISTORY

SBASE VERSION 2.0 01-Dec-92

Menu Option 3. Input Two-line Data.

This is the main change from version 1. Option 3 has been added, and the existing menu options renumbered. This enables NASSA Two-line Keplers to be read from a file.

I have found that there is a problem if this file contains non-ASCII characters. If the data is edited with WORDWISE, always SPOOL the output data. If you SAVE the data instead, WORDWISE puts a HEX 02 character near the end of the file which causes the computer to crash. I plan to make the program less sensitive to non-ASCII characters in the next issue.

Menu Option 4. Input UOSAT data.

This used to be a very useful feature, which I used sucessfully for many years. However there has recently been a problem with two changes of format on the satellite, and an error in the actual data being transmitted. At the present time this service is suspended. I do not know when the service will be resumed, or whether there will be any more changes to the format. You will notice that the demonstration file RAW contains 1989 Keplers!

SBASE VERSION 2.1 23-Feb-93

Menu Option 7. EQX Generation.

The PLAN10 procedure PROCsatvec has been modified to calculate decay correctly. DT=DC*T/2 has been changed to DT=DC*T at line 8260. Refer to OSCAR News 93, 94, and 95, pages 27, 23, and 22 respectively, for a discussion of this problem.

If you use the EQX method you should remember that many of these older programs such as ASCOT do not compensate for drag after the EQX has been calculated. It should be posible to improve them by using the drag factor from the Keplerian part of the data base, although I haven't tried this.

ALLSAT Version 1.1 23-Feb-93

PLAN10 modified as above. I am working on an improved version of ALLSAT which will have much better display and printing options for the output.