

**GB4FUN**  
**Satellite Set-up Information**  
**Antenna installation**  
**and**  
**Operating guide**



**Introduction**

The satellite equipment onboard GB4FUN may at first appear a little daunting, it is recommended that if there is an AMSAT member in your group, obtaining their assistance would be useful! but this does not mean you cannot achieve successful results without such assistance, even if you are unaccustomed to the mode of operation.

The information that you should have prior to setting up is your “Latitude, Longitude and Station Height in meters”, this will be required by the tracking program to pinpoint your location.

This information is available from a number of sources i.e. ordinance survey maps, auto route, GPS systems, if however your proposed operating site is known in advance the details can be programmed at HQ prior to your collection of GB4FUN.

As a simple analogy try thinking of Satellite operation as “mobile repeater operation in reverse” i.e. your station remains in one place and the satellite moves.

The following pages are designed to try and assist you in successfully setting up and operating through the various satellites available.



**GB4FUN**  
**Satellite System Parts Lists**  
**Required for setting up**

<b>Items</b>	<b>Description</b>	<b>Location</b>
<b>QTY</b>		
1	Rotator mast assembly	Vehicle floor
1	G3RUH Dish and fibreglass boom	“ “ “ “
2	10mm U clamps	Tool Box      11    1 11
1	145Mhz X-Quad w/pre-amp	Vehicle floor
1	70cm X – Quad w/pre-amp	Vehicle floor
3	Coaxial feeders each labelled	
1	D/C Dish, 2M X-Quad, 70cm X-quad, Rotator control cable	

**Tools required**

<b>QTY</b>	<b>Description</b>	<b>Location</b>
1	10mm Spanner	Tool Box
1	Spirit level	Tool Box
1	Compass	Tool Box

**NOTE:-** *Before commencing setting up all the above items with exception of the Rotator mast assembly should be safely placed on the roof*



**AMSAT- UK**

## GB4FUN Satellite Antenna System Setting Up

*Please note for Safety this should be done after the side steps and handrail has been put in place!*

The mast attached to the Yaesu rotator is secured by the two clamps on the passenger side of the vehicle.

You should not fully tighten the clamps at this stage so as to allow for the final positioning of the antenna array.

The 2m X-Quad, 70cm X-Quad and G3RUH Dish with Fibreglass pole should then be placed on the roof of GB4FUN, this is easily accomplished from the side door.

The 2 clamps which are used to secure the fibreglass pole through the rotator will require a 10mm spanner, the only other 2 tools required are a compass and a spirit level all of which are in the tool box.

The rotator is marked with the words “Front” and “North” both the words should be on the same side, (if not the rotator position will need to be reset by the controller, this can be done after the antennas have been assembled).

The Fibreglass pole with the Dish should then be inserted through the upper part of the rotator, with the G3RUH Dish facing the “front” / “north” and the down converter in the upright position as in fig 1.



Fig 1:- G3RUH Dish with Down converter installed on “front”/ “north” of rotator assembly.

***TIP “The connector for the elevator section will be behind the dish”***

Allow a couple of inches gap between the side of the dish and the rotator to clear the connector and rotator housing while in operation.

Place the spirit level on the front of the patch (the metal disk that the converter is bolted to) and ascertain that the dish is in a level plane, then tighten the two rotator clamps, (10mm) do not over tighten and remember it is only a fibreglass pole and it will break if excessive force is used, and then recheck with the level.

The 70cm X-Quad is mounted on the same side as the dish, and pointing in the same direction, but on the end of the pole, the inside of which has been reinforced with aluminium to prevent it easily cracking, as in Fig 2 the pre-amp must be in the upright position, Again the spirit level should be used to ascertain that the antenna is level before the (10mm) clamps are fully tightened.



Fig 2:- The 70cm X-Quad attached to the boom with the pre-amp in the correct position,

The 2m X-Quad is mounted on the other side of the rotator again at the end of the pole on the reinforced section, the antenna pre-amp must be in the upright position as in Fig 3 and the antenna must be pointing in the same direction as the 70cm and the dish, the spirit level should be used before the (10mm) clamps are fully tightened to ensure the antenna is level.



Fig 3:- The 2m X-Quad fitted on the boom relative to the dish and with the pre-amp in the correct position

*TIP As indicated earlier if the securing clamps to the vehicle are not fully tightened it is quite easy to turn the whole assembly while mounting all the antennas.*

The three labelled coaxial cables should now be attached to the antennas, the one labelled D/C is attached to the G3RUH Dish via the n-type tail, the one labelled 145MHz goes to the pre-amp on the 2m X-Quad and the 430MHz cable is attached to the pre-amp on the 70cm X-Quad.

The 2 rotator cable connectors should also be attached the one marked elevation goes to the upper section of the rotator, (Behind the dish) and the one marked Azimuth goes to the lower body of the rotator.

When all the above has been completed the whole array must be pointed North! This is essential to give the computer tracking software a reference starting point, this is easy accomplished using the supplied compass and turning the boom manually until the whole array is pointing North.

After the above has been achieved, fully tighten the clamps on the side of the vehicle to prevent any movement on the rotator mast. Remember the antennas are rotated and elevated thus the coaxial and rotator cables should be given enough slack to allow this to take place as in Fig 4. **Failure to observe this will damage the array.**

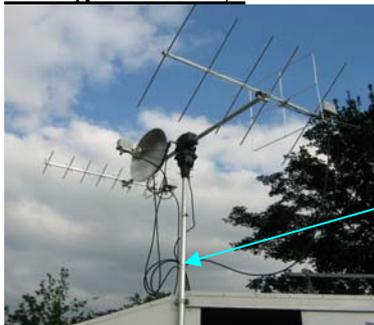
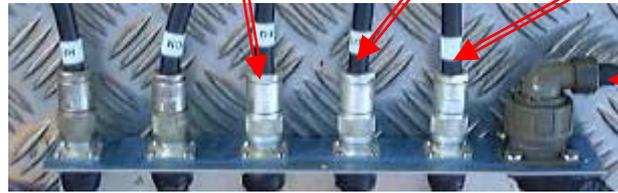
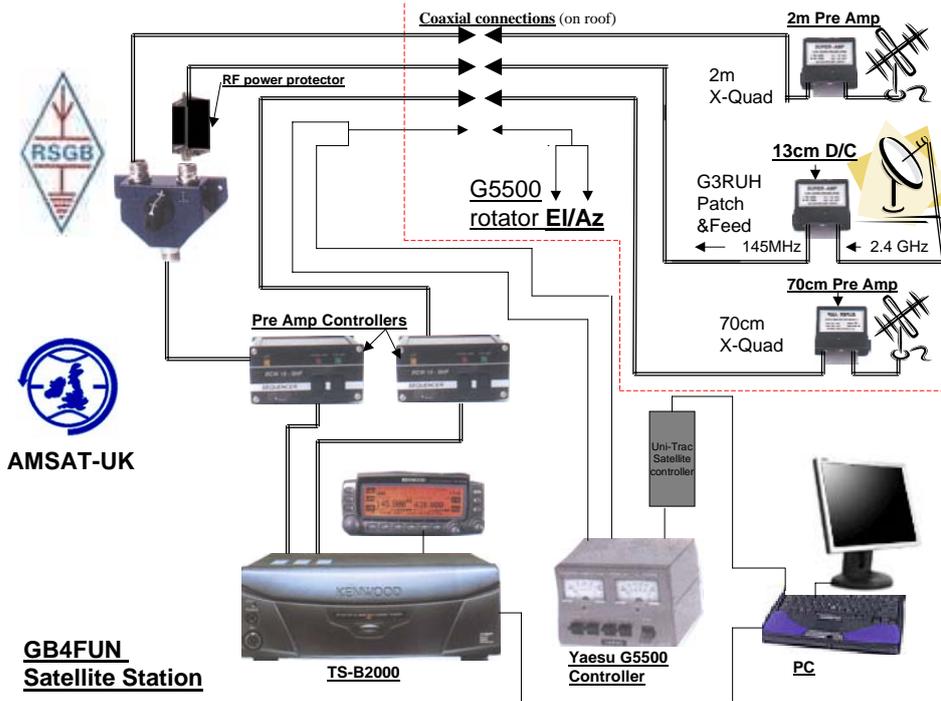


Fig 4:- all the antennas mounted with all the cables attached, a large reusable cable tie, holds the cables to the rotator mast while still allowing for slack. *TIP Remember the whole assembly must be pointing North.*

The other ends of the co-axial cables and the rotator cable are the connected to the roof top N-Type panel, **70cm X-Quad**, **Dish D/C** **2m X-Quad**



Rotator connector



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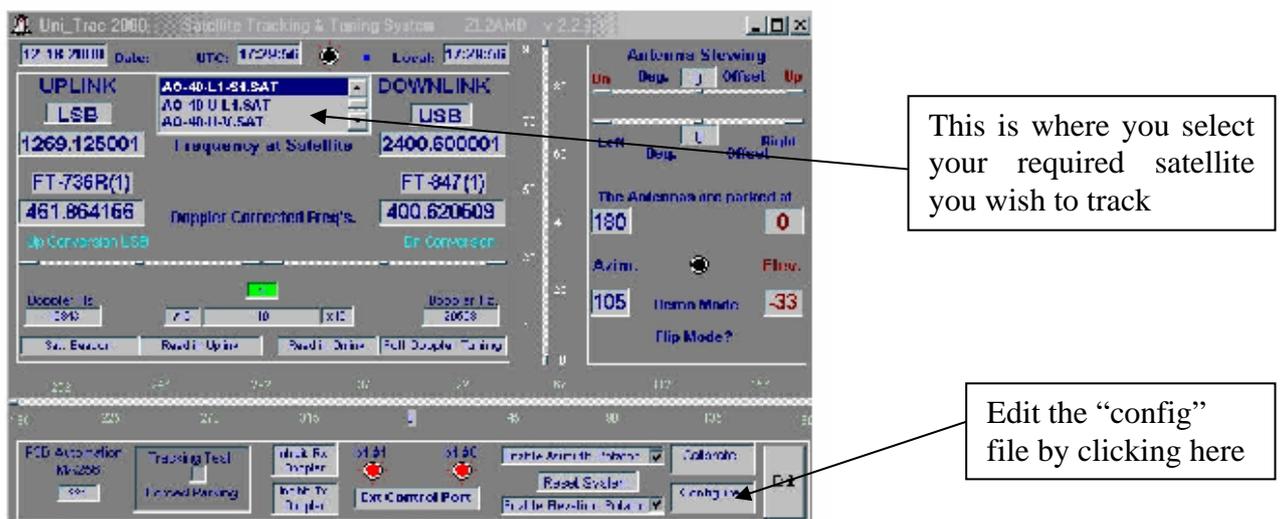
**GB4FUN**  
**Satellite Station**



## GB4FUN Setting up the Satellite Station. Computer & Radio

GB4FUN's Satellite station is fully computer controlled, the satellite tracking, rotator control and radio operation software is all installed on a computer, which is located under the operating bench.

To turn on the computer all that is required is to push once the button located on the front of the machine which is located on the right of the box as you view it . After the WINXP operating system screen is displayed, there are 3 icons, which you will have to click on and then minimise the screen to gain access to the other two. The first icon is labelled UNI-TRAC and is the rotator control program, you will need to turn the rotator control unit to the on position, then click on the icon and you will then be presented with a screen picture as in fig 1



You will need to change the configure information by clicking where indicated above, and clicking on the edit UNI-CFG box, you will then be presented with a text .cfg file which looks like this.

Latitudes SOUTH of the Equator and Longitudes WEST of Greenwich are entered as negative quantities.

i.e. -39.234

Your station's latitude?  
=-39.542

Your station's longitude?  
=176.869

Your station's height above Mean Sea Level in meters?  
=7

There are only 3 things you need to change in this file and that is  
Your Latitude  
Your Longitude  
Your station height.  
*NB if your known station location is provided prior to using GB4FUN this can be done for you*

Once the changes have been made please save and close the program and then restart to enable UNI-TRAC reset to the new parameters.

Then select the satellite you wish to track by selecting it from the box as illustrated above.

*NB Ensure you do not close the program but only minimise to enable it to work in the background.*

The next program you should start is NOVA, this program is used to predict which satellites will be available and for how long, it is not essential to accurately provide NOVA with your location details as it is not used in the tracking of the satellite's, it does however require you to choose from a list which satellites you wish to have information on, You should restrict this to about 4 satellites ie: AO51, FO29, SO50, ISS etc to prevent the screen from becoming unintelligible.

NOVA is quite a simple program to use, all it requires is that you follow the on screen instructions when its starts up.

All of the Keplerian data is updated regularly at HQ so will not require any other changes to be made.

NOVA does not need to be restarted when any parameters are changed.

The final program to be used is the Kenwood ARCP-2000 radio control program. When starting this program you will find by clicking the SAT button on screen that most of the used satellites have been programmed into memory to assist in a faster set-up.

The full operating manual for the TS-B2000 is located in the tool cabinet to allow you make which ever changes you require.

**PLEASE NOTE:-**

**IT IS IMPORTANT THAT WHEN YOU CLOSE DOWN THE STATION THAT THE UNI-TRAC PROGRAM IS TAKEN OFF LINE AND THE ROTATOR PLACED IN ITS STARTING POSITION BY THE MANUAL CONTROL BOX "NORTH AND 0 DEGREE ELEVATION".**

The following text is advice as to how to operate through various satellites including the ISS.

**FM Units**

**ISS: International space station**

Down-link 145.800MHz FM (Packet & Voice)

Up-link 145.990MHz FM (Packet)

Up-link 145.200MHz FM (Voice)

It's pretty consistently on digital 1200 AFSK, with occasional (if you're very lucky) adhoc voice QSO's. Digital AFSK can be set up pretty easily using the ARCP-2000 control program (TX RX -> Terminal). There is no need for Doppler correction, just antenna pointing.

Because the up-link and down-link are on the same band, full duplex operation is not used. The TS-2000 will not let you up-link and downlink on the same bands anyway. You will need to set up a split and for future use write it into a memory.

You need to set up the internal TNC to 1200bps, on the correct band (main or sub), set the TNC callsign, set the UNPROTO CQ VIA RS0ISS. Also set PASSALL ON and MCON ON and MCOM ON. You can then CONV and fire off a couple of packets as well as seeing yours and others come back. Don't try to connect: this is a UI digipeater only at present.

There is an AFSK beacon every minute or so on the ISS on 145.800.

Just in case the ISS comes up on voice, you might want to keep a memory set or the 145.200/145.800 up/down, again NOT using the radio's satellite mode.

### **AO-51**

Down-Link 435.300 MHz FM 2401.200 MHz FM

Up-Link 145.920 MHz FM 145.880 MHz FM 1268.700 MHz FM

It requires a 67Hz tone sub-audible to be constantly transmitted to access and is Frequency Agile, It is a must to check AMSAT-NA Schedule for daily frequency changes

### **SO-50:**

Down-link: 436.800MHz FM

Up-link: 145.850MHz FM

It's easy to hear, but requires a 67Hz tone sub-audible to be constantly transmitted to access, it is not always switched on

### **SSB Units**

#### **AO-7**

Down-link: 145.925 - 145.975 MHz USB

Up-link: 432.125 – 432-175 MHz LSB

Beacon 145.975 CW Beacon

Sunlit operation only

#### **FO-29:**

Down-link: 435.850MHz +/- 50kHz USB

Up-link: 145.950MHz +/- 50kHz LSB

Beacon: 435.795 +/- Doppler is CW.

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#### **VO-52**

Down-link: 145.900MHz +/- 30kHz USB

Up-link: 435.250MHz +/- 30kHz LSB

Beacons: 145.936 +/- Doppler unmodulated carrier

145.860 Telemetry

The passband on AO-7, FO-29 and VO-52 is inverting: this means that you up-link in LSB and it comes back as USB. In addition, if you up-link in the upper part of the transponder passband it comes back in the corresponding lower half.

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The sequence of making a QSO on a SSB linear transponder with `_manual_` Doppler correction is...

(a) Set to SATL mode and set your down-link to 435.850 USB and your up-link to 145.950 LSB.

(b) Set Trace and Reverse on (reverse because it's an inverting

- transponder). (You might want to save this away in a memory for later).
- (c) Tune to a clear part of the passband.
  - (d) Switch off Trace.
  - (e) Set your up-link to CW.
  - (f) Key up the CW and simultaneously tune the down-link (+/- 12kHz) until you hear your own CW up-link.
  - (g) Zero beat the down-link.
  - (h) Switch the up-link back to LSB.
  - (i) You should be on frequency - try talking and you should hear your own down-link. Adjust down-link again slightly if not.
  - (j) Switch Trace back on.
  - (k) Retune to the middle of the passband to call CQ or answer a CQ call.
  - (l) You will need to continually alter your up-link/down-link throughout the pass to stay on frequency.

**PLEASE NOTE:-**

**IT IS IMPORTANT THAT WHEN YOU WISH TO CLOSE DOWN THE STATION THAT THE UNI-TRAC PROGRAM IS TAKEN OFF LINE AND THE ROTATOR PLACED IN ITS STARTING POSITION BY THE MANUAL CONTROL BOX "NORTH AND 0 DEGREE ELEVATION".**



## **SETTING UP THE SATELLITE SYSTEM in the KENWOOD TS-B2000**

### **Using the ARCP 2000 computer interface**



There are two ways to toggle the Satellite function ON or OFF:

- 1) Click [SATL].
- 2) Under the "TX RX" menu in the Menu Bar, select "Satellite", then select "Satellite" from the pop-up menu.

### **SWITCHING TRACE ON/OFF**

There are two ways to toggle the Trace function ON or OFF:

- 1) In the "Satellite Operation" frame, click [TRACE].
- 2) Under the "TX RX" menu in the Menu Bar, select "Satellite", then select "Trace" from the pop-up menu.

There are two ways to **reverse** the Trace contents:

- 1) In the "Satellite Operation" frame, click [REV].
- 2) Under the "TX RX" menu in the Menu Bar, select "Satellite", then select "Rev." from the pop-up menu.

### **SATELLITE MEMORY INPUT**

Enter data into satellite memory channels as follows:

1. While Satellite operation is running, click [M. IN] in the memory operation frame to enter Satellite Memory Scroll mode.
2. In the "Click Enc./Step" frame, click [UP] or [DOWN] to select a channel.
3. To set up a memory name, click [DISP] to open the "Satellite Memory Name" window, then enter your desired memory name.
4. Click [M. IN] again.

If the ARCP-2000 software is in "Satellite Memory Scroll" mode, the transceiver will not enter "Satellite Memory Scroll" mode.

*Note:- You cannot use a ";" (semi-colon) in the Satellite Memory Name parameter. This is because the ";" (semi-colon) is used as the terminator in the PC Control Command specifications. Although you can enter ";" (semi-colon) using the transceiver keys, ARCP-2000 cannot display the ";" (semi-colon) character.*

### **RECALLING SATELLITE MEMORY CHANNEL**

To recall a satellite memory channel, operate the Click Encoder while in "Satellite" mode.

The "Click Encoder" function must be set up in Satellite Memory Recall mode. Refer to "SWITCHING THE CLICK ENCODER FUNCTION".

### **SWITCHING THE DISPLAY**

There are two ways to switch the Display:

- 1) In the "Satellite Operation" frame, click [M/S].
- 2) Under the "TX RX" menu in the Menu Bar, select "Satellite", then select "M/S" from the pop-up menu.

### **SWITCHING THE CLICK ENCODER FUNCTION**

There are two ways to switch the Click Encoder function:

- 1) In the "Satellite Operation" frame, click [VFO/CH].
- 2) Under the "TX RX" menu in the Menu Bar, select "Satellite", then select "Click Enc. Function" from the pop-up menu.

The light in the "Click Enc./Step" frame turns on when the Click Encoder function is set up in Satellite Memory Recall mode.



## GB4FUN Satellite system



### Some handy do's and don'ts for general satellite operating.

**Do** ensure that the rotator is set to front and north before set-up and before removing from the vehicle when dismantling.

**Do** ensure that the Satellite aerial switch is set to the (A) 145 MHz position when operating on all VHF up-link or down-link satellites and the Sequencer is switched on only when the down-link receiver pre-amp is required.

*(NB:- the receive pre-amp is only currently used for satellites AO-7, VO-52 and ISS that down-link within the 2m Band).*

**Do** ensure that the aerial switch is turned to the (B) D/C position and the 145 MHz sequencer is switched on to power up the receive converter if attempting to receive a 13cm signal such as from AO-51.

**Do** ensure that the TS-B2000 is in split frequency (*Program A and B VFO's*) mode not in satellite mode when operating simplex to the ISS.

**Do** ensure that the time (local) and date are correctly displayed on the computer, (*any error will prevent the tracking software from operating correctly.*)

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**Don't** change the time on the computer to GMT as the satellite-tracking program already takes the one-hour difference during BST into account.

**Don't** change the date code from USA to English/British as the Uni-Trac satellite-tracking program works with USA date code.

**Don't** place the TS-B2000 into satellite mode to operate to the ISS (*International Space Station*) the transceiver will not allow you to up-link and down-link on the same band!

**Don't** alter any other parameter of the computer radio control software, satellite tracking or computer operating system other than that stated in the GB4FUN handbook, unless you are fully conversant with all the set-up procedures.

The results of unauthorised or incorrect adjustments will render the satellite system inoperative

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**GB4FUN Analogue Voice & Weather Satellite list**

**TS-B2000 (+ FT-897D for AO-27 / Kitsat B & SO-50 / SaudiSat 1C)**

<b>Satellite</b>	<b>Down-link</b> Frequency in MHz			<b>Up-link</b> Frequency in MHz			
	from	to	mode	from	to	mode	
<b>1 <u>AO-7 / OSCAR 7</u></b> Cat No (7530)	<u>B 145.975</u>	<u>145.925</u>	USB/CW	<u>432.125</u>	<u>432.175</u>	LSB/CW	<u>145.9775 CW Beacon</u>
	<u>A 29.400</u>	<u>29.500</u>	USB/CW	<u>145.850</u>	<u>145.950</u>	USB/CW	
<b>2 <u>AO-51 / Amsat Echo</u></b> Cat No (28375)	<u>435.300</u>		FM	<u>145.920 *</u>	<u>145.880</u>	FM	<u>* 67Hz PL tone required</u>
	<u>2401.200</u>		FM	<u>1268.700 *</u>		FM	<u>!AO-51 is Frequency Agile!</u>
<b>3 <u>FO-29 / JAS 2</u></b> Cat No (24278)	<u>435.800</u>	<u>435.900</u>	USB/CW	<u>146.000</u>	<u>145.900</u>	LSB/CW	<u>435.795 CW Beacon</u>
<b>4 <u>AO-27 / KITSAT B</u></b> Cat No (22825)	<u>436.795</u>		FM	<u>145.850</u>		FM	
<b>5 <u>ISS (zarva)</u></b> Cat No (25544)	<u>145.800</u>		FM/Packet	<u>145.200</u>		FM	
			Voice R M	<u>145.990</u>		Packet	
				<u>437.800</u>		Cross Band Repeater uplink	
<b>6 <u>SO-50 / SaudiSat 1C</u></b> Cat No (27607)	<u>436.795</u>		FM	<u>145.850 *</u>		FM	<u>* 67Hz PL tone required</u>
							<u>!SO-50 needs 74.4 Hz to arm the 10 minute timer</u>
<b>7 <u>VO-52 / Hamsat</u></b> Cat No (28650)	<u>145.870</u>	<u>145.930</u>	USB/CW	<u>435.220</u>	<u>435.280</u>	LSB/CW	145.936 Unmodulated Carrier Beacon
							145.860 Telemetry Beacon

**NOAA Polar orbiting weather satellites. Frequency in MHz**

1 NOAA-12 137.500

2 NOAA-15 137.500

3 NOAA-17 137.620

3 NOAA-18 137.9125

(NOAA-18 also uses 137.100 check schedule)

The TS-B2000 has an internally generated oscillation on 436.800! Thus to operate through SO-50 / SaudiSat 1C or AO-27 / Kitsat B, use the TS-B2000 for the uplink (with tone if required) in simplex mode and the FT-897D for receive.

Note:- This will require the coax from the 70cm X-Quad to be attached to the FT-897D radio.

**GB4FUN Manual Doppler corrected frequency chart for FM voice satellites**

**S0-50 + 67 Hz PL / AO-27**

Pass Position	Frequency pairing in MHz	
	Down-link	Up-link
<b><u>AOS</u></b>	436.805	145.8465
<b><u>b</u></b>	436.800	145.84825
<b><u>MID</u></b>	436.795	145.850
<b><u>d</u></b>	436.790	145.85175
<b><u>LOS</u></b>	436.785	145.8535

**ISS**

Pass Position	Frequency pairing in MHz		
	Down-link	Up-link	Up-link voice repeater mode
<b><u>AOS</u></b>	145.8035	145.1965	437.790
<b><u>b</u></b>	145.80175	145.19825	437.795
<b><u>MID</u></b>	145.800	145.200	437.800
<b><u>d</u></b>	145.79825	145.20175	437.805
<b><u>LOS</u></b>	145.7965	145.2035	437.810

**AO-51 + 67Hz PL**

Pass Position	Frequency pairing in MHz	
	Down-link	Up-link
<b><u>AOS</u></b>	435.310	145.9165
<b><u>b</u></b>	435.305	145.91825
<b><u>MID</u></b>	435.300	145.920
<b><u>d</u></b>	435.295	145.92175
<b><u>LOS</u></b>	435.290	145.9235

Example:-

On an approx 12 minute pass, you should start at with **AOS** frequency pair then move to next listed frequency in 3 minutes , continue to **MID** at the 6 minute mark then next pair at 9 minutes, ending with **LOS** frequency pair at the 11 minute mark.

Down-link = Receive

Up-link = Transmit

AOS = Acquisition of Signal

MID = Satellite is overhead

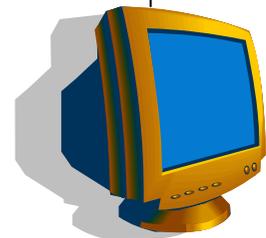
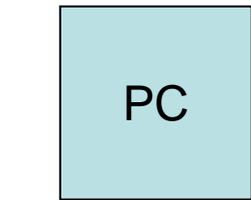
LOS = Loss of signal



# GB4FUN Satellite Station



AMSAT-UK



Uni-Trac  
Satellite  
Tracker

Yaesu  
G5500  
Az-El  
Controller

Kenwood  
TS-B2000

SSB DCW  
15  
Sequencer

SSB DCW  
15  
Sequencer

← GB4FUN  
Shack

→ Mast

SSB RF  
Power  
Protector

SPDT  
Coax  
Switch

SSB  
UEK  
3000

SSB  
SP2000  
Preamp

SSB  
SP7000  
Preamp

Yaesu  
G5500  
Rotator



G3RUH  
Patch & Feed

WIMO  
Phasing  
Harness

WIMO  
145MHz  
X-Quad

WIMO  
Phasing  
Harness

WIMO  
435MHz  
X-Quad



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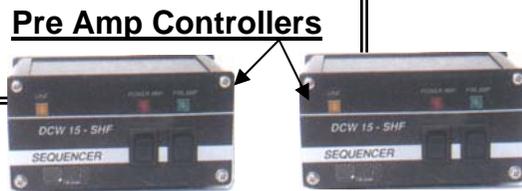


FT-897D

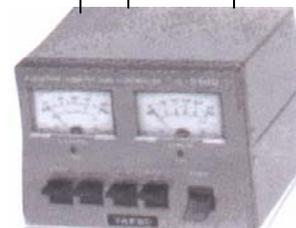
GB4FUN  
Satellite Station



TS-B2000



Pre Amp Controllers



Yaesu G5500  
Controller

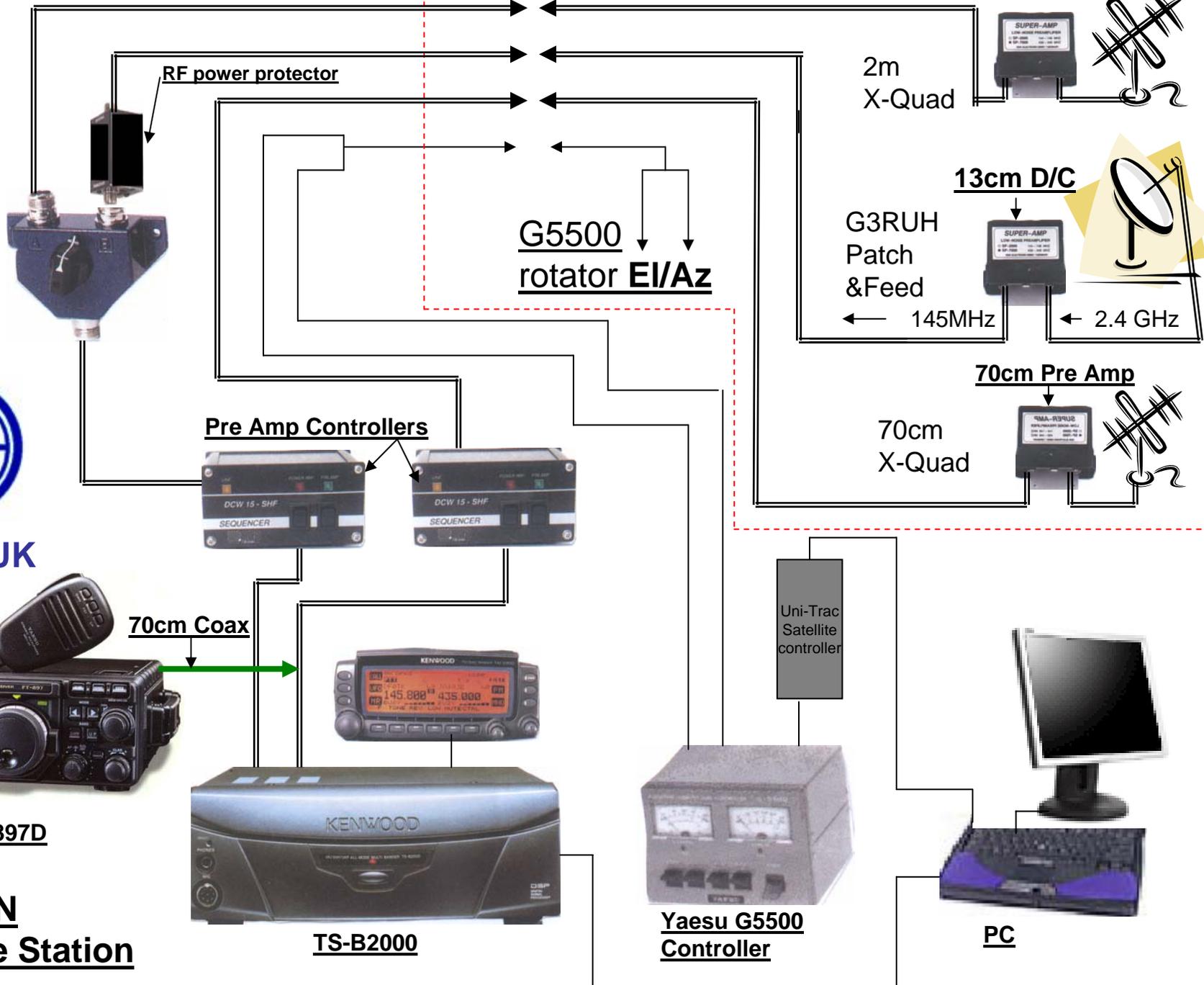


PC



Uni-Trac  
Satellite  
controller

Coaxial connections (on roof)



RF power protector

G5500  
rotator EI/Az

2m Pre Amp

2m  
X-Quad

13cm D/C

G3RUH  
Patch  
& Feed

← 145MHz

← 2.4 GHz

70cm Pre Amp

70cm  
X-Quad

70cm Coax