

Orion Extending Frequency Information

The purpose of this document is to state facts about the Orion Mobile radio that can be of use to those "Hams" who wish to use the Orion radio in the amateur service.

- If the Orion is used on a ham band for which the Orion is designed there is no problem. Using the radio to operate outside of the range for which it is FCC type accepted would be a violation by some individuals' interpretations. However, that is not true if it used only on the ham bands by a licensed amateur radio operator. The FCC knows we are going to mess with radios and if we interfere with other services, then we have to correct the problem. One should not modify the radio to operate outside the band and use it to communicate in any other business or public safety service. That could be tricky opinion by some judges.
- The Orion has two voltage control oscillators (VCO) - one for the transmitter and one for the receiver. There is only one phase lock loop for both TX and RX.
- The range of the VCOs is divided into segments. The range of frequencies for the VHF high for instance is divided into four segments. To cover the frequency range of 150 to 174 or 24 MHz, the VCO operates over four segments, each covering 6 MHz. This means that the voltage to control the VCOs reach the highest level 4 times over the full range of the band of frequencies. Tuning the VCOs to just any frequency can cause the radio to not work across the entire band. Tuning of the VCOs is not published, but can be done by tuning to the highest test frequency for modulation in a given band. The voltage should be very near 6 volts. If the VCO is tuned, one must verify that the VCOs lock on each of the modulation test frequencies. The test frequencies are shown in the maintenance manual for each band of operation.
- The Orion has a fixed resistor on the synthesizer RF board that identifies the band of operation. It is often called the radio ID or "RF Type" resistor. The program for the Orion, called the BIN or BIZ file will check this resistor during programming and operation to make sure the frequencies that are stored in the Orion agree with the band. If there is a discrepancy, an error message will be produced as well as operation will cease.
- There are four different programming packages for creating the personality for the Orion. The personality contains the data used by the "BIN" file. This data is the frequencies and options. Of the four packages, two are Windows95 (later revisions required newer MS Windows) and above while the other two are MSDOS versions. The two packages within an operating system are further divided into EDACS trunking and conventional or non-trunking. The only packages presently sold and supported by M/A-COM is the Windows versions. The difference between the EDACS (trunking) and conventional version is the ability to program or write the data to the trunking radio. The screens appear to be the same. The price of the two varies by a factor of at least 10 or \$250 versus \$2000. The software is not freeware or shareware, so using it without the license is theft. However, if one can find the "CONV1" software, one could rationalize that one is using "out-of-date" unsupported software so it must not be theft. This package is more than adequate for most "Ham" applications. Later versions of the Windows programming software only support Windows 2000 and XP. Go with XP because the Windows 2000 often would not work the serial comm. ports correctly.

- The “bin” code or executable program is loaded into the Orion in a process called “flashing”. The code has had many updates or revisions over the life of the radio. There are over 45 different revisions. There are also further divisions of the code relative to the hardware of the radio or flash size – 256k versus 512k. Revisions above group 32 added very little to conventional operation of the Orion. Dual control head operation was added around G22. Vehicular repeater operation was added sometime around G28. Refinements to vehicular repeater operation were done in the next few versions. OG32300.bin or OG32400.bin would be the most logical code to be running in the Orion for “Ham” use. Group 32 code is the last one for the 256 k memory Orions. The G in the name means Group and the next 2 numbers is the version of the code. Therefore OG32300 is Group 32 code for a 256 k memory radio (300). Group 46 code did add a feature where the scanned channel would become the selected channel if the add/delete button is pressed up two times while hearing a call in the scan mode. (I could be a little off on the exact operation at this time. Besides it is in software and could change.) Sometimes the bin code has the extension of “BIZ”. This is a zipped version of the code that is unzipped inside the radio after flashing. It is no different in operation from a bin file of the same name.
- The DOS based programming software has the unique feature of being able to take out of band frequencies. This is done by simply pressing control “e” when leaving the frequency data field. (The Windows version will not take the “control e” insert.) Before one gets hope up, this will not work on the Orion. The radio personality will be created with out of band frequencies, but the Orion will not take it. An error will occur during programming. Remember the “RF Type” resistor. The value of this resistor identifies the band of operation and the Orion will not take this “faulty” personality.
- Maybe there is another way. Could one just change the resistor so that the proper band is chosen? This would only create another problem. Take for instance, that the “RF Type” resistor (R480) is changed from the VHF High 150-174 MHz split to VHF High 136-153 MHz split. The radio will appear as a low split radio and will program as a low split, but now it will not take frequencies that are in the high split. Frequencies are allowed only within the split of operation. That is OK, because one only wanted to cover the Ham frequencies, which are in the low split. It still will not work. Don’t forget about the VCO segments. Programming 146.52 in the Orion will cause the radio to select the segment for 144.05 to 147.995, which is using the components picked for 161.505 to 167.495 for the high split. It will not lock on frequency. The VCOs will not tune 20 MHz away from their design frequency. One will have to replace or change components to cover the desired segment. Finding the right split “synthesizer/RF” board would be the ideal method.
- Will the VHF high split PA cover the low split frequencies? – Yes! Will the VHF low split PA cover the high split frequencies? Maybe, but degraded. The low pass filter will cause attenuation for the upper frequencies. “Hams” aren’t interested in this anyway.
- How can one get the VHF Low (36-50 MHz) to cover the 6-meter band or make the Orion UHF cover 430 to 450? There is not a way unless one has or creates a special code. (Back to this later.)
- This comment does not work, but why stop. The DOS based programming software contains a “Special” band that can be edited. One can create a special radio that has a low frequency of say - 40 MHz and a high of 53 MHz. The personality can be created

without error checking within these limits. The radio would need to have a special “RF Type” resistor (1 K ohm) installed for R480. The problem here is the Orion bin code has lost the ability to read the “special band” resistor value. This happened sometime around g16 bin code or a long time ago. (Damn it! The bastard’s killed Kenny!) So, forget the “Special” band.

- There is a “special” way of creating unusual requirements for the Orion, especially in the international marker. This special way is simply a text file that passes “special codes” to the Orion during programming. These text files are called SC or SC4 files. SC is for the DOS version EDACS3 or CONV-1 files, and the SC4 files are “Special Code” for EDACS4 or the Windows programming” software. The contents of these files are different for the applicable software to accomplish the same thing. In other words, they are not interchangeable. To use the “SC” files, they must be passed to the programming software with a “\SC filename” command. If one edits the older MRK batch file (before M/A-COM) that calls the programming software, the file would look like:

```
CD \GE\conv1\mrk
\GE\conv1\mrk\conv1 %1 %2 %3 %4 %5 %6 %7 %8 %9
CD \GE
```

The %1, %2, etc. simply pass the commands on to the “CONV1” software. So if one executes the software with “mrk /sc filename”, it should load the special code. One should place the path of the SC file with the filename or place the SC file in the \GE\CONV1\MRK directory. One could create their own bat file to execute the programming software with their special code. Assuming one has a special code named lbplus4.sc (The special code file must have the extension “sc”.) and the file was located in the radio directory, the bat file would look like:

```
CD \GE\conv1\mrk
\GE\conv1\mrk\conv1 /sc \ge\conv1\radio\lbplus4
CD \GE
```

Saving the bat file with the name “lbplus4.bat” would create an easy way to run the special code.

- Here is an example of a SC file for moving low band frequencies up 10 MHz.

```
/T9 /f1 /w2
/T9 /f2 /wAE
/T9 /f3 /wA5
/T9 /f4 /w40
/T9 /f5 /w2
/T9 /f6 /wAE
/T9 /f7 /wA5
/T9 /f8 /w40
/T9 /f9 /w2
/T9 /fa /wAE
/T9 /fb /wA5
/T9 /fc /w40
```

This would be a straight ASCII text file with a name with an extension of sc, such as “LBPLUS10.SC”. Looking at the content one can see that the data is arranged as a table containing data that follows the /w. There appears to be a further division, where the data is repeated in groups of 4 lines. These three groups should have the same data

for VHF low band, VHF high band and UHF, but not 800 and 900 MHz. Apparently a group represents, trunking, talk around, and conventional over different bands of operation. There is a difference for the 800 and 900 MHz band because they have different TX and RX bands. Let's stay focused on the VHF and UHF bands, even though there is a 900 MHz ham band. The grouping is not important, when the data is repeated in each group of four.

What does the data mean? Again, this table offsets the 35 – 50 MHz Orion to operate 10 MHz high. Start by determining the low end of the band of coverage or in this case 35 MHz. Add a desired offset or 10 MHz, so now the low end of the band will be 45 MHz. Using scientific calculator convert this frequency to a hexadecimal number. In this case 45000000 decimal equals 2AEA540 in hex. The answer is divided into four, two digit hex numbers and each hex number is entered on the first four lines and then repeated for the next two sequences of four lines. Observe the file and see the pattern. Before you start playing with this, stop and think for a minute. A 10 MHz offset for low band probably will not work, because the VCO segments are not 10 MHz wide.

Here is another one. Assume one has a 150 – 174 MHz Orion and one wants to program 146.52 into the Orion. Looks like the Orion will have to have its low band edge moved to 146.000 MHz. Convert 140000000 to hex or "8B3C880". Put the data into a text file or:

```
/T9 /f1 /w8  
/T9 /f2 /wB3  
/T9 /f3 /wC8  
/T9 /f4 /w80  
/T9 /f5 /w8  
/T9 /f6 /wB3  
/T9 /f7 /wC8  
/T9 /f8 /w80  
/T9 /f9 /w8  
/T9 /fa /wB3  
/T9 /fb /wC8  
/T9 /fc /w80
```

Save the file as HB-4Meg.sc

Call the MRK programming software by typing "MRK /sc HB-4Meg.sc."

- How does one create a personality to use with the sc files? Whatever the offset is will be added or subtracted from the frequencies entered in the frequency sets of the personality. Assuming the previous sc file "HB-4Meg.sc", entering 150.52 into a channel will result in 146.52 being programmed into the radio. Reading the personality back from the radio will show 146.52 as the frequency.
- Programming the Orion with the offset frequencies does not guarantee that the synthesizer will lock on the new frequencies. Remember the segments, they do not move with the offset. In the above example, one could tune the VCOs to lock on 145.52 MHz, but keep the tune voltage as low as possible and still lock. Now the Orion will probably not lock at the upper end of the segment or in this case, near 155.495 but it will lock above 155.505, which is in the next segment.
- Making the Orion lock at the upper end of 6 meters will be impossible without retuning and possibly changing a few parts. It will probably lock at 52 MHz, but not 53 MHz

without tuning the highest frequency to 6 volts for the tune voltage. Then one can kiss 45.2 MHz goodbye, if one is still trying to work the volunteer fire department. Hams don't do that, so no problem! Remember that power at 53 MHz will be low, because of the low pass filter in the power amplifier.

- Never edit a file read from a radio when using the sc file. Writing it back to the radio will offset the file again. Always edit and write the original file.
- Here are some examples of SC files. Simply create them with a text editor and pass them on to the programming software.

	2 MHz Lower	1 MHz Lower	10 MHz Higher
SC Files	/T9 /f1 /w8 /T9 /f2 /wD2 /T9 /f3 /w4D /T9 /f4 /w00 /T9 /f5 /w8 /T9 /f6 /wD2 /T9 /f7 /w4D /T9 /f8 /w00 /T9 /f9 /w8 /T9 /fa /wD2 /T9 /fb /w4D /T9 /fc /w00	/T9 /f1 /w8 /T9 /f2 /wE1 /T9 /f3 /w8F /T9 /f4 /w00 /T9 /f5 /w8 /T9 /f6 /wE1 /T9 /f7 /w8F /T9 /f8 /w00 /T9 /f9 /w8 /T9 /fa /wE1 /T9 /fb /w8F /T9 /fc /w00	/T9 /f1 /w2 /T9 /f2 /wAE /T9 /f3 /wA5 /T9 /f4 /w40 /T9 /f5 /w2 /T9 /f6 /wAE /T9 /f7 /wA5 /T9 /f8 /w40 /T9 /f9 /w2 /T9 /fa /wAE /T9 /fb /wA5 /T9 /fc /w40

- What about SC4 files for ProGrammer – the Windows programming software? SC4 files are text files like SC files. To use SC4 files, ProGrammer must have the SC4 Files enabled in the Option screen. The personality of the radio must call the SC4 file by naming the file in the General Options dialog box of the radio Options folder.
- The syntax for the lines that control the frequency tables is different than the SC commands. Those may be addressed in another document or revision to this one.