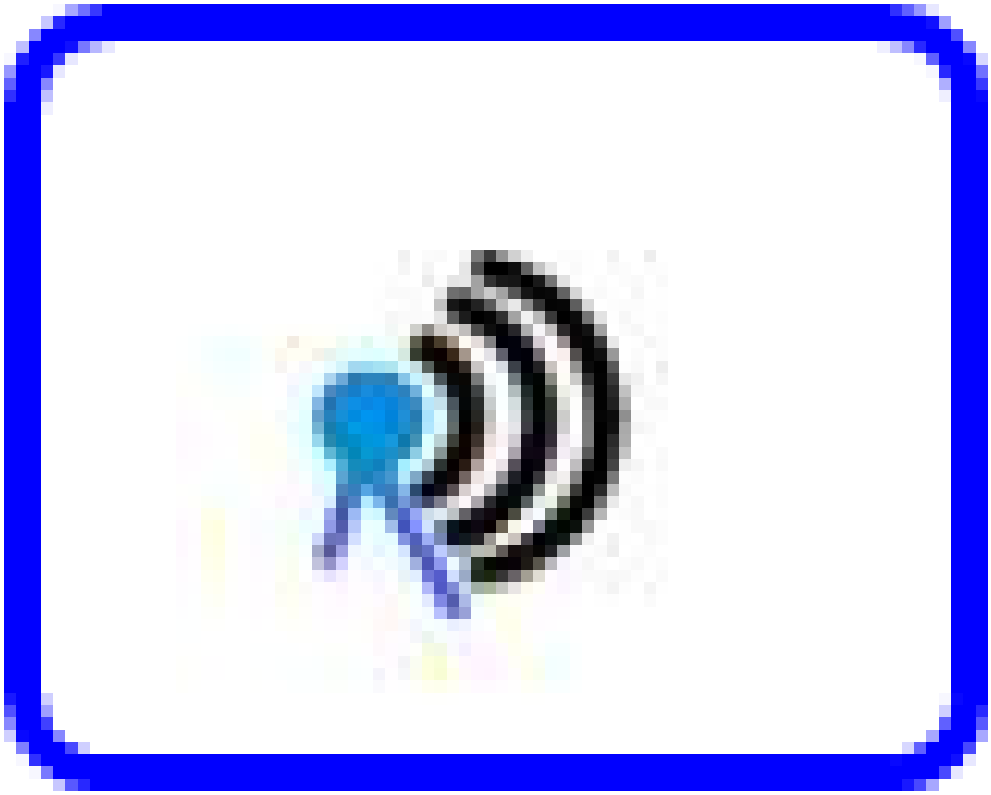
FREQUENCY FINDER



USER MANUAL

Version 22

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User manual for the program FREQUENCY FINDER (FF)

1. Introduction

1.1 The user manual provides a step-by-step guide through the various functions that can be performed by the user of FREQUENCY FINDER (FF) to assist in facilitating frequency assignment planning by States and the Regional Offices.

1.2 In conjunction with the development of FF, the ICAO Aeronautical Communications Panel (ACP) has updated the technical basis for frequency assignment planning. The result of this work is incorporated in the ICAO *Handbook on Radio Frequency Spectrum Requirements for Civil Aviation,* Vol. II, *Frequency assignment planning criteria for aeronautical radio communication and navigation systems* (Doc. 9718). The first edition (2013) includes frequency assignment planning criteria for VHF COM systems. Material for other ICAO communication and navigation systems is in preparation. The most recent version of this Handbook (Volumes I and II) can be downloaded from the ACP website (Repository section)

1.3 FF has been developed with FileMaker Pro 12 Advanced. This program provides, in addition to very flexible data base management functionalities, numerous options to develop specialized functionality that greatly assisted in the completion of FF, which provides for calculations to assess compatibility of frequency assignments, presentation of calculation results with a graphical interface (such as Google Earth) and for networking.
Note: Frequency Finder is not compatible with version 11 or lower of FileMaker Pro.

1.3.1 FF is available in a full version and a runtime version. The full version requires FileMaker Pro 12 (preferably the *Advanced* version) to be installed on your computer. The runtime version can run from your computer without the need for installing FileMaker Pro Advanced. The runtime version does not allow you to modify FF and cannot export data in the format of Adobe PDF files. Apart from these constraints, the functionality of the runtime version is similar to that of the full version.

1.3.2 FF requires the use of Google Earth. Google Earth is freely available from the website http://www.google.com/earth/download/ge/agree.html .

1.4 FF is constructed in a modular manner and, in its final format will include modules the support the following main functions:

a. frequency planning for VHF air/ground voice and data link systems (**VHF COM list**)

b. frequency planning for VHF/UHF navigation aids (ILS, VOR, DME, GBAS) (**VHF NAV list**)

c. frequency planning for NDB (**NDB list**)

d. frequency planning for HF air/ground voice and data communications (**HF list**)

e. planning of SSR Interrogator Identifier codes (**SSR list**)

In addition, FF will include (provisional) modules to support RNAV assessments, prediction of propagation losses, information on airway route structure and FIR sectors etc. A nitial version of the module to support assessment of RNAV based on DME-DME navigation is included and currently subject to testing and improvements, with the active participation of ICAO Regional Offices.

1.4.1 The current version of FF includes the completed module to support frequency assignment planning for VHF air/ground communication systems (VHF COM database) operating in the frequency band 117.975 – 137 MHz. The frequency assignment planning criteria for FF are based on radio equipment designed for 25 kHz frequency spacing. However, when calculating potential interference, FF also allows the user to test compatibility of frequency assignments with 8.33 kHz channel spacing (as in a mixed environment where systems with both 25 kHz and 8.33 kHz channel spacing are operating).

1.4.2 The module for VHF/UHF navaid (VHF NAV list) planning is also included in FF and is currently subject to a final assessment. This module tests compatibility of ILS and VOR frequency assignments against the criteria currently used in various ICAO Regions, with the exception of the EUR Region. Several modifications to this module are expected to be introduced before this module is completed.

1.4.3 The module that supports the coordination of SSR Mode S Interrogator Identifier codes (SSR list) is available and will be included in FF in the near future.

1.4.4 Completion and introduction of the modules for HF frequency assignment planning (HF list) as well as for NDB frequency assignment planning (NDB list) is expected by the end of 2014.

1.5 FF is using a Global Database of frequency assignments. This database is placed on a server n ICAO HQ. The Global Database is a (simple) concatenation of the separate ICAO Regional COM lists. These Regional COM lists have been reformatted in the format required for FF. The Regional Offices can access and introduce changes to the Global Database which support their activities for the coordination of frequency assignments. The Global Database is available for use by the ICAO Regional Offices which have direct access through the FileMaker Pro Network. To fulfill their obligation to coordinate and register new or modified frequency assignments, only the Regional Offices have the privilege of updating the Global Database. States can access the Global Database for browsing and downloading only.

The EUR Regional COM lists are maintained through the SAFIRE database, managed by Eurocontrol. This database is, in particular to support inter-regional coordination, incorporated in the Global ICAO data base and at frequent intervals the Global database is to be updated with the SAFIRE data base.

1.5.1 Other users of FREQUENCY FINDER (e.g. States) can use either the runtime version or the full version of FF which can be installed as a stand-alone program on a local computer. It is currently anticipated that the Global Database of frequency assignments can be downloaded by States from a secure ICAO website and readily imported into FREQUENCY FINDER. This would provide users with access to the most current version of the Global Data base when using the FF. The current (paper) distribution of the Regional COM lists by ICAO may no longer be necessary.

Note 1: If desired by States, a feature can be implemented that will generate for a new or a modified frequency assignment a compatibility report that is ready for mailing or e-mailing to the relevant Regional Offices. The format of this report should be considered by States and the Regional Offices.

Note 2: The use of a graphical display that would permit visualizing the coverage at lower altitudes, taking into consideration the effect of the terrain is being considered.

1.6 FF provides traditional database functionality, allowing for the manipulation of the Global Database of frequency assignments on a local computer (e.g. query the database, add/modify/delete frequency assignments, and creation of COM lists) as well as functionality to calculate and present the results of any frequency assignment compatibility assessment. A geographical interface (Google Earth) has been included to visualize the data and the calculation results on a map. However, any change to the Global Database of frequency assignments that resides on the ICAO web can only be introduced by the relevant ICAO Regional Offices.

1.7 A schematic overview of the various functions of Frequency Finder, including references to this manual, is in Appendix E. This Appendix contains step-by-step guidance of the functionality of FREQUENCY FINDER.

1.8 FREQUENCY FINDER has been developed primarily to provide the Regional Offices with a tool to update the Global Database of frequency assignments. The Global Database of frequency assignments is an element the eANP which is being developed by ICAO and can, where required, linked to other tables or lists of the Global Air Navigation Plan (e.g. the Surveillance lists or the Air Routes. The Global Database of frequency assignments is published on the ICAO website.

FREQUENCY FINDER offers the capability to assist in the compatibility assessment as well as the identification or search for new frequency assignments.

FREQUENCY FINDER can be used by States for national purposes or for pre-coordination of frequency assignments prior to submitting these to the Regional Office for international coordination and/or registration in the Global Database.

The implementation of the Global Database of frequency assignments requires harmonization of the current Regional COM lists into the format of the Global Database. This harmonization is being coordinated with each Regional Office.

1.9 As noted in paragraph 1.2 above, a complete set of frequency assignment planning criteria for VHF COM systems has been developed by the ICAO Aeronautical Communications Panel and approved by the Secretary-General. These planning criteria are intended to update, as required, the current Regional planning criteria. Implementation of these planning criteria requires in many cases amendments to the relevant Regional Air Navigation Plans. These planning criteria have been published by ICAO in the *Handbook on radio frequency spectrum requirements for civil aviation,* Volume II, *Frequency assignment planning criteria for aeronautical radio communication and navigation systems* (Doc. 9718)

1.9.1 The planning criteria as published in this Handbook have been incorporated in Frequency Finder. The method of implementation is explained in Appendix H.

1.10 A special window has been developed that would allow user (Civil Aviation Administrations) to generate, in the appropriate format, the T12 and T13 Notices that are necessary for the electronic submission of frequency assignment Notices to the ITU for incorporation in the ITU Master International Frequency Register (MIFR). These Notices need to be submitted to the ITU through the national telecommunication authorities. The method for the generation of these notices has been coordinated with the ITU and is further described in Appendix F. (in preparation)

1.11 FIR Sectors and area services (ACC)

1.11.1 For frequency assignments that are planned to or have been implemented to provide area services such as ACC or FIS (Flight Information Service) a table with the coordinates for the polygons describing these area services has been incorporated in Frequency Finder. This data is derived from both the Poly EUR database with coordinates for the area services used in the EUR Region (source: SAFIRE) and the program ICAOFIR XX that contains the coordinates of all FIR sectors. This data allows for the plotting on a map of the relevant geographical area, the part of this area that is covered by relevant VHF ground stations and for the calculation of the protection of the relevant frequency assignments that are used throughout the area. The table with these coordinates needs to be updated at regular intervals. Such updating is to be performed manually. As and when these tables are available on the ICAO website, such updating can be performed automatically.

2 Installing Frequency Finder

2.1 Operating systems

2.1.1 Frequency Finder has been tested with Windows XP, Windows Vista and Windows 7 (32 and 64 bit) with the latest Service Packs installed. FREQUENCY FINDER has been developed with FileMaker Pro 12.

2.1.2 Administrator rights may need to be enabled on some computers to use FREQUENCY FINDER.

2.2 Installing Frequency Finder with FileMaker Pro Advanced:

When FileMaker Pro Advanced (version 12 or higher) is installed on your computer, the full version of FF can be used. Copy the file ***Frequency Finder [version#].fmp12*** to the local computer at any location as desired; no other installation of FF is necessary.

2.2.1 The full version of FREQUENCY FINDER cannot be used on computers where FileMaker Pro Version 11 or lower has been installed. Programs or databases developed with FileMaker Pro 12 are not compatible with earlier versions of FileMaker.

2.2.2 Each time when FF is started the program checks if the folder *ICAOfrequencydownload* and the necessary sub-folders have been installed on the C:/ drive of your computer and downloads certain files which are embedded in FREQUENCY FINDER into these folders. These folders and files are essential for the correct functioning of FF. In case these folder are not [yet] installed (or have been removed) FREQUENCY FINDER will create these folders. Certain computers may need administrative rights to install these folders and files on the C:/ drive. For more information on the folders that are being used by FF see § 3.2).

2.3 Installing Frequency Finder with the runtime version:

2.3.1 In case FileMaker Pro Advanced 12 is not installed on your computer, the runtime version of FF can be used. Copy the folder **Frequency Finder** to the computer at any location on your computer.

Do NOT run the program from a CD or USB drive, as this significantly slows down the operation of the program. Some computers may need to have Administrator rights to be enabled to install the runtime version of Frequency Finder.

2.4 Google Earth

2.4.1 FF requires the use of Google Earth. Google Earth is freely available from the website. When starting using FF, Google Earth starts automatically.

2.4.2 Some users may need access to administrator rights to install Google Earth

2.4.3 Google Earth requires a screen resolution of at least 1024x768 to be viewed properly. Google Earth may run with a lower screen resolution but the layout and the use of Google Earth may not be optimized.

2.4.4 It is recommended to set in the **Google Earth Options** dialog the **Fly-to speed** to **Fast**. On the Google Earth menu bar click **Tools** / **Options** and tab **Navigation.** On the tab **General** click **"Silently accept all unrecognized data"**.

2.5 Downloading FREQUENCY FINDER

2.5.1. The most recent version of FF can be downloaded from the ICAO website at http://192.206.28.81/FF1/FF1.php . This website is provisionally and will be replaced with a more stable website. From this website also the global database of VHF COM air/ground communication frequency assignments can be downloaded.

2.6 Pop-up dialog boxes.

In numerous cases, the user of FF is requested to select options from pop-up dialog boxes. FileMaker does not display in all cases the full text in these dialog boxes. The size of these boxes can be increased by the user by clicking on the border of these dialog boxes and increasing manually the size to view the full texts.

2.7 Updating of the global database of frequency assignments.

2.7.1 The global database of frequency assignments, which is regularly updated by the Regional Offices, is to States through the ICAO website. This database can be imported in Frequency Finder as and when desired by the user. However, only the Regional Offices are authorized to modify the data base and add, delete or change the characteristics of frequency assignments. States can use this data base to support their own planning activities.

3 Using Frequency Finder

3.1 Open Frequency Finder

3.1.1 The full version of Frequency Finder can be started by clicking the file **Frequency Finder <*filename*>** (e.g. Frequency Finder 20Z.fmp12) that has been copied to the computer where FileMaker Pro Advanced 12 has been installed (see §2.2).

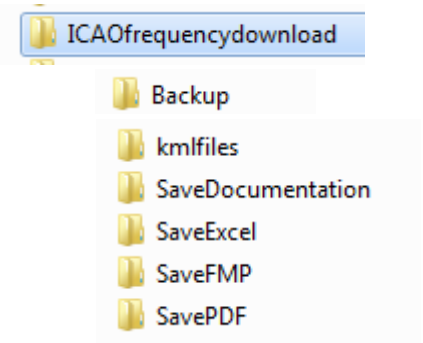
3.1.2 The runtime version of Frequency Finder can be started by clicking the file **FF.exe** which is located in the (runtime) folder **FF** (see also §2.3).

3.2 FileMaker folders

3.2.1 During each start-up, FF will check the existence of the folder *ICAOfrequencydownload* on the C: drive and, if necessary, create this folder and various sub-folders. This folder and the sub-folders are essential for the correct functioning of FF. Files that are generated by Frequency Finder (e.g. for the back-up of data) are stored in these folders. Also, some files that are required for the functioning of Frequency Finder and are embedded in the program are stored in these folders.

3.2.1.1 The files that generate the data that is displayed with Google Earth are typically of a temporary nature. To avoid clogging your computer with these files, they are placed in a TEMP folder which is created by FileMaker when opening Frequency Finder. From time to time, these TEMP files are deleted. These TEMP folders can be accessed with the buttons on the Start page of Frequency Finder (See § 3.2.2.2 and § 3.2.2.3).

3.2.2 Folder ICAOfrequencydownload on the C;/ drive The structure of the folders that are created on your C:/ drive by Frequency Finder is as follows:



These folders have the following functionality:

Backup – this folder contains the backups of the tables the user has selected for backing up. Tables that are used in Frequency Finder and of which a backup copy can be made are:

ICAO COM list 3; Global database of frequency assignments

PolyEUR – contains the coordinates of the area services in the EUR Region and of all database of FIR sectors (global)

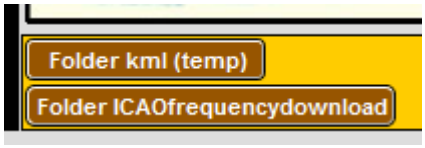
kmlfiles – this folder is no longer used; the specific files generated by Frequency Finder for plotting data on the map with Google Earth are stored in a TEMP folder (see § 3.2.1.1, § 3.2.3 and § 3.2.4).

SaveDocumentation – this folder contains the picture files (.png) used as "thumb-tag" when creating the kml files which are used to present information with Google Earth. Each time you start Frequency Finder these files are copied from Frequency Finder to your computer.

SaveExcel, SaveFMP and SavePDF – these folders contain the files that have been saved by the user in either Excel, FileMaker or PDF format. Further information on the generation of these files is in § 4.4 of this Manual.

3.2.3 Special Files (kml-files; Keyhole Markup Language) are generated by Frequency Finder. The files provide for the graphical interface with which certain functions performed by FF can be displayed on a map with Google Earth. Examples are the plotting of the coverage of VHF ground stations or the plotting of interfered areas. These files are created by Frequency Finder "on the fly" and are saved in a temporary folder that is created by FileMaker when starting Frequency Finder. Since the operating system of the computer controls the location of temporary files, the exact path returned to this TEMP folder may be different between computers. These temporary folders and any files placed in it are deleted when Frequency Finder / FileMaker Pro is terminated.

3.2.4 The button "Folder kml (temp)" on the Start and the VHF COM Home Pages opens the relevant temp folder on the local computer. This folder contains in the format of "kml-files" primarily the geographical data that has been generated by Frequency Finder for displaying geographical information on the map with Google Earth. Further information on the structure of kml files is on the website for Google Earth.



The button "Folder ICAOfrequencydownload" opens the folder *ICAOfrequencydownload* on the C:/ drive. These buttons are placed on several windows to provide easy access to these in case the user wants to access these folders.

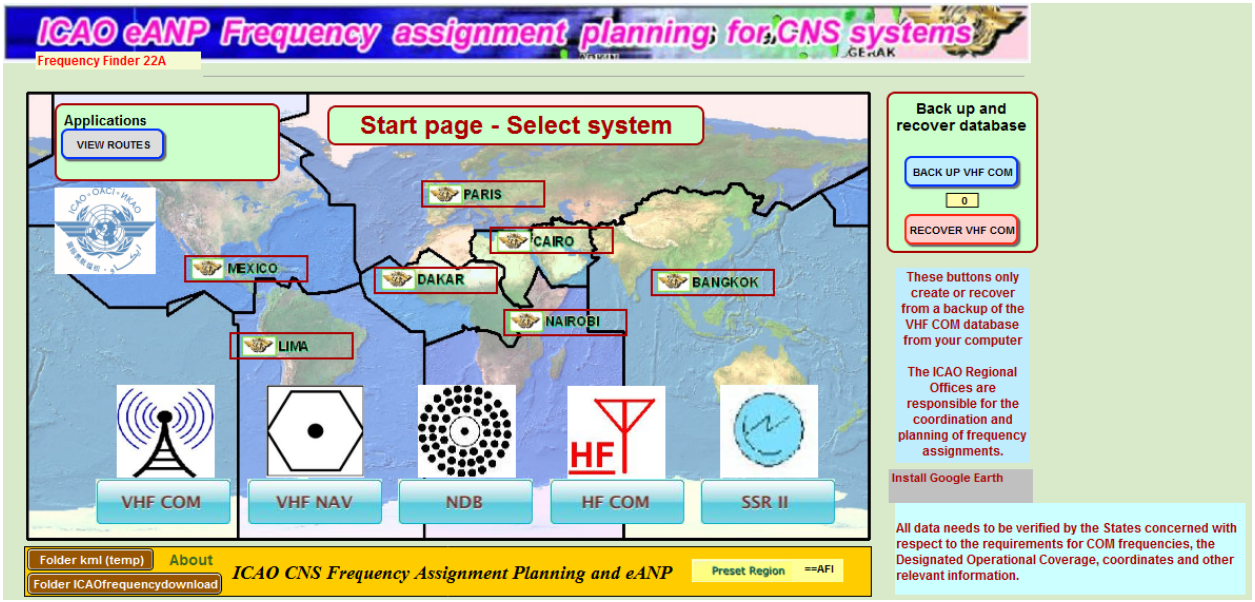
3.3 FileMaker toolbar

3.3.1 All functionality necessary for running FF is provided on the toolbar of Frequency Finder through buttons and menus as outlined in this manual. In both the full and the

runtime version the original FileMaker toolbar has been disabled. It is strongly recommended to not enable the FileMaker Pro toolbar or to use the functions provided on the FileMaker toolbar. Using the FileMaker toolbar may give unexpected results.

3.4 Start Page

Frequency Finder opens with the **Start Page**:



The **Start Page** provides the user with the following functionality:

i. Access to the websites of the Regional Offices
ii. Navigate through the various modules and applications provided in FF.
iii. Create backup of the database of frequency assignments or recover from a backup.
iv. Preset to the Region from where you are operating

3.4.2. On the start page buttons have been located that provide for a direct link to the websites of the ICAO Regional Offices

3.4.3 Navigation to the database of frequency assignments.

These buttons will take the user from the **Start Page** to the **Home Page** of the various modules that have been included in the program:

VHF COM - this button will open the home page for the database of frequency assignments for VHF air/ground communication systems.

VHF NAV - this button will open the home page for the database of frequency assignments for VHF/UHF navigation aids (ILS, VOR, DME and GBAS) (only for testing)

NDB - this button will open the home page for the database of frequency assignments for LF/MF beacons (NDB and Locator). (In preparation)

HF COM - this button will open the home page for the database of frequency assignments for High Frequency (HF) air/ground communication systems. (In preparation)

SSR Mode S II - this button will open the home page for the database of SSR Mode S Interrogator Identifier codes. (In preparation)

Note: In case no Region has been preset (see §3.4.6) a popup dialog box will invite the user to preset a Region to facilitate the use of a Regional database.

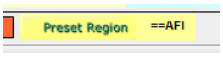
3.4.5 Applications.

An application that allows for plotting on the map the air routes as well as for the identification of in particular DME stations within range of the air route can be accessed with the button **VIEW ROUTES**

This application is described in Section 9 of this Manual.

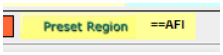
Other applications, such as plotting on the map of FIR sectors (and ACC sectors) as well as determining coverage at lower altitudes, taking into consideration the effect of the terrain, may be added in due course.

3.4.6 Preset Region

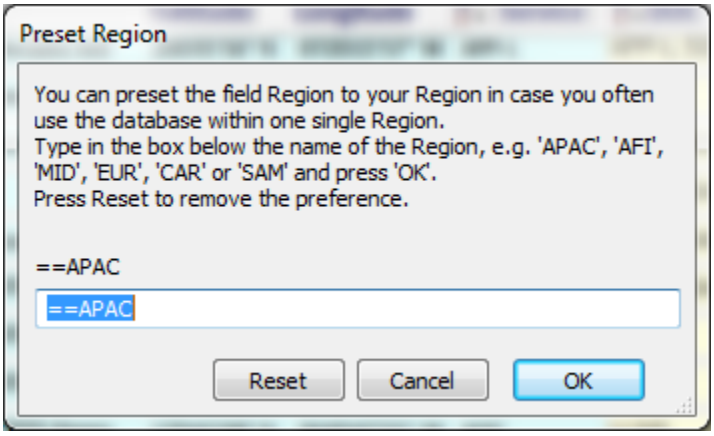


At the bottom of the window Start Page the button enables FREQUENCY FINDER to be preset to a single Region. This feature has been introduced to facilitate the use of the Regional database as in many cases users are expected to browse the database and perform the necessary functions within one single Region. When the program is preset to a Region, FF facilitates the navigation to (parts of) the relevant Regional database. Preset Frequency Finder to the Region from where you are operating is strongly recommended.

*Note: although FF may show a regional subset of the Global Database (e.g. either as a result of a query or of a preset Region), when performing compatibility calculations **ALL** relevant frequency assignments in the global database within the range of 1020 NM from the station being tested are being considered to secure (interregional) compatibility of frequency assignments. Further information on the algorithm that is applied is in paragraph 4.6.1.*

To preset FREQUENCY FINDER to a particular Region, click the field/button 

Clicking the field **Preset Region** triggers the pop-up dialog box:



When typing in this box the name of the Region, e.g. AFI, followed by the button “OK”, the (yellow) field **Preset Region** on the Home page, the Start page or the window **VHF COM database** will show “==AFI”. After having preset a Region, the Frequency Finder returns the Regional COM list for that Region.

Note: In various cases throughout FREQUENCY FINDER the Region name, Country name or Location name are preceded by the characters ==. This permits FileMaker Pro to search (and find) for an exact find of the name. Example: ==Guinea Bissau finds only Guinea Bissau and not also Guinea or Papua New Guinea.

To remove the Preset Region, click the button **Reset** on the pop-up dialog box. This will empty the box ”Preset Region”.

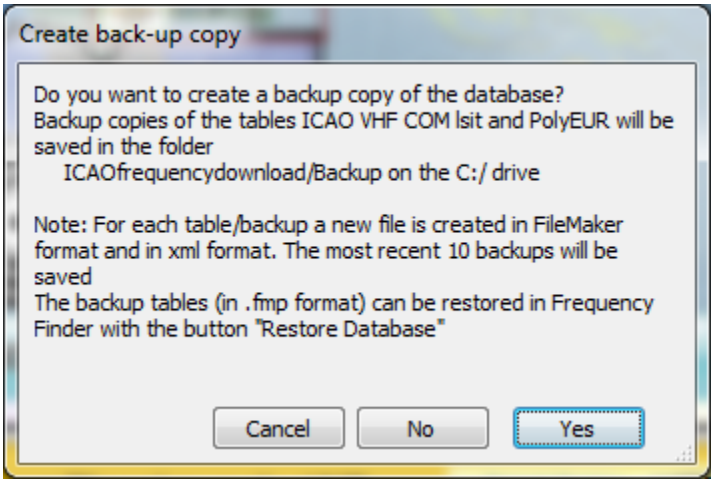
This function has been placed on different windows (e.g. the Start page, the Home Page and the page "VHF COM database").

3.4.7 Back-up and recovery from the backup.

3.4.7.1 Creating a backup copy of the database of frequency assignments

The database of frequency assignments can be backed up (on your local computer) and it is possible to restore the database from these backups. Back-up of the database of frequency assignments and the table with polygons for area services is triggered automatically when **Frequency Finder** is closed and offers the user to create a back-up copy of the databases. Backing up the database can also be triggered with the button BACK UP VHF COM which is placed on both the Start page and the Home page of each module.

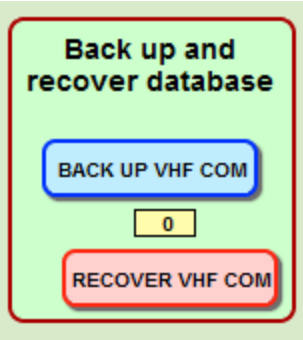
When a back-up is triggered, the popup menu "Create back-up copy" shows:



The backup copy of your local database will be placed in the folder *ICAOfrequencydownload/Backup* on the C:/ drive of your computer. A back-up copy of the list of frequency assignments as well of the list of coordinates for polygons (for area services) is created; each of these lists is saved in xml and the FileMaker Pro fmp format.

The back-up copy includes all frequency assignments in the (global) data base as well as any modification to this data base the user made on his local computer.

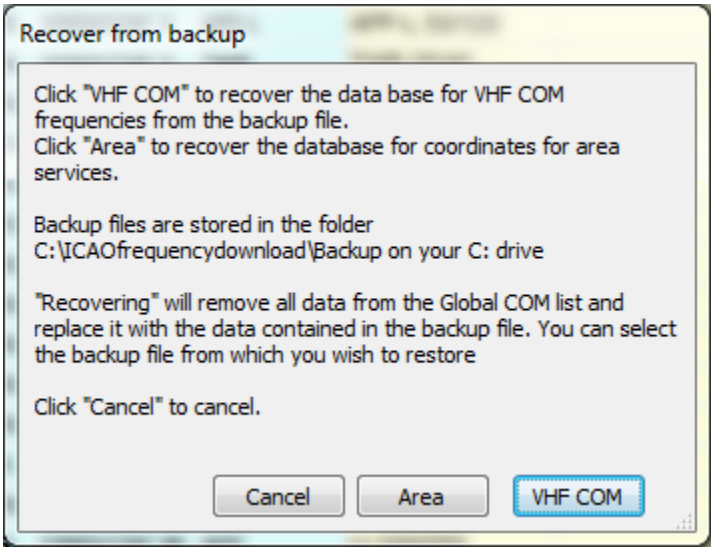
The number of the most recent backup is shown in between the buttons Backup VHF COM and Recover VHF COM; this number is contained in the filename of the back-up file



Up to 10 different copies of the database can be made. The 11th (and further) back-ups will restart numbering from 1 and over-write (replace) the first back-up of the database. This has been implemented to avoid cluttering of your computer with backup copies of the database.

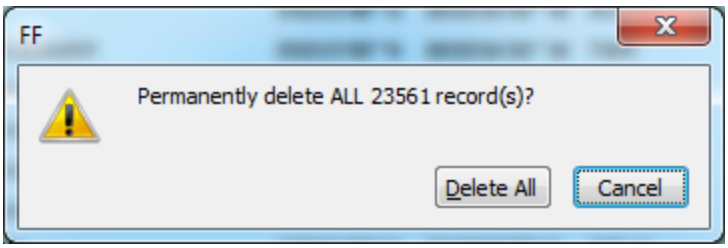
3.4.7.2 Restoring the database of frequency assignment from a backup copy.

With the button RECOVER VHF COM on the start page the user can restore the database of frequency assignments from a local backup copy. A popup dialog box will request the user to continue with the recovery or to cancel:

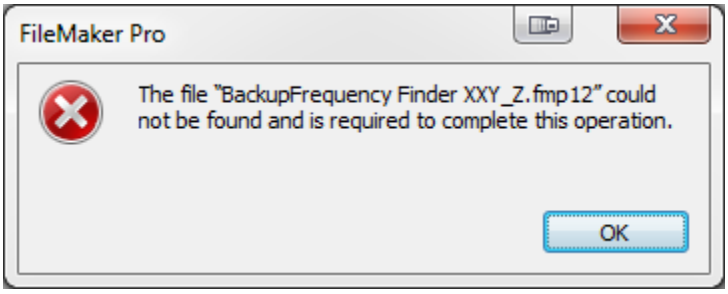


The user can select to either restore the database of VHF COM frequency assignments with the button "VHF COM" or the database with coordinates for the area services with the button "Area"

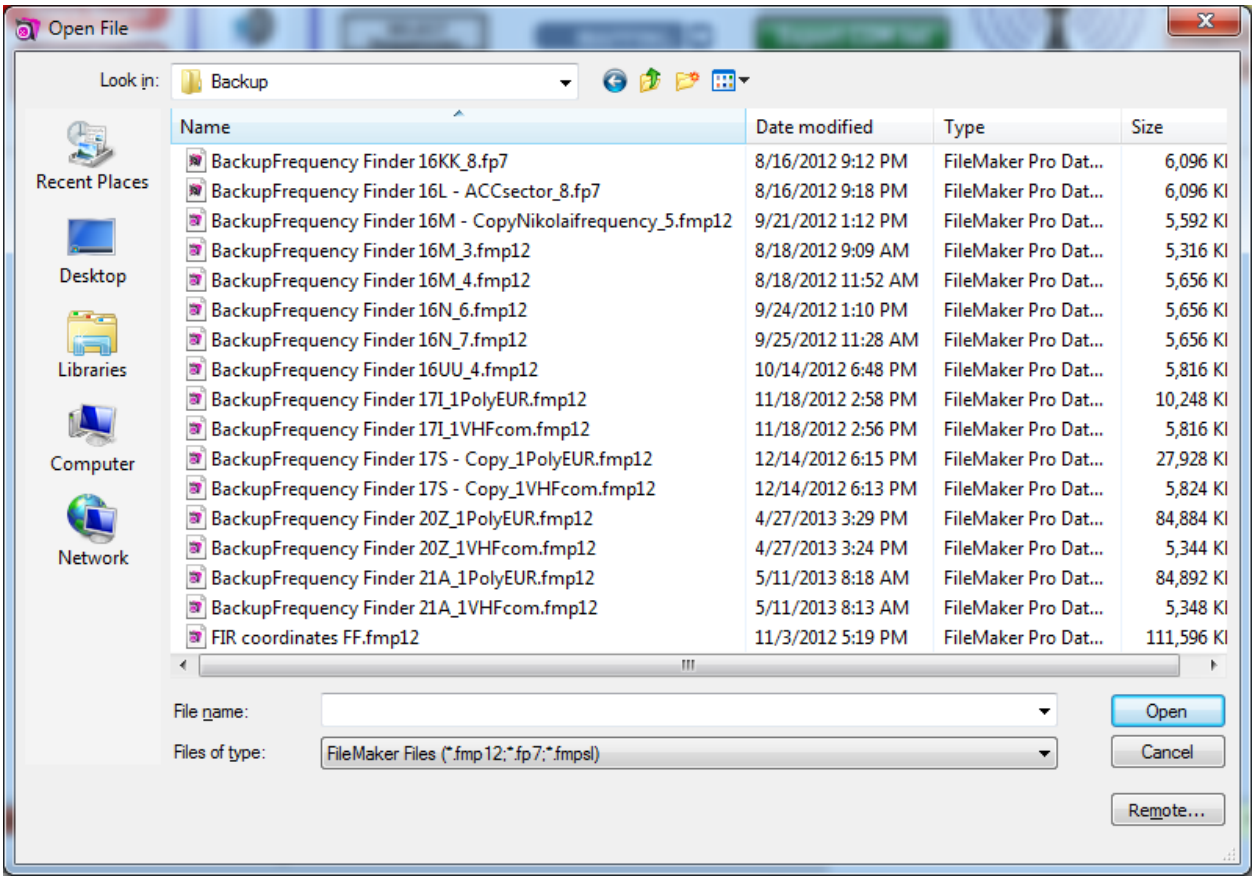
After selecting either the button **Area** or the button **VHF COM**, the user is requested to confirm the deletion of all records (either the frequency assignments or the coordinates of the polygons for the area services) in the current database of Frequency Finder:



After deleting the records as confirmed by the user, Frequency Finder will search for the file from which the database needs to be restored and a popup dialog box will show:

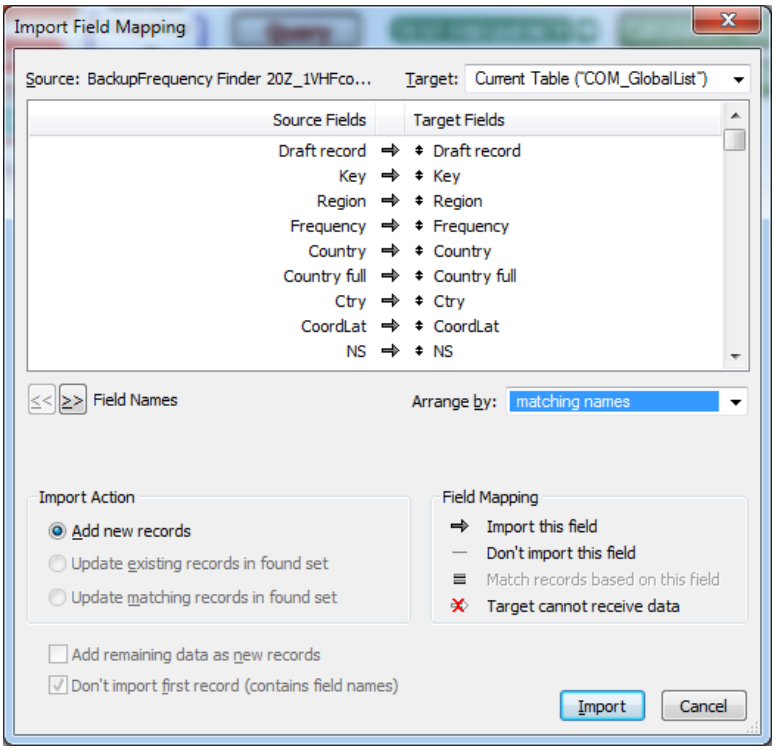


Click "**OK**" and set the in the pop-up dialog the box *Files of type* to "FileMaker Files" (fmp12) and navigate to the folder **C:/ICAOfrequencydowload/Backup**. Select from the list of files from which FileMaker Pro back-up file (with the extension ***.fmp12***) the database should be restored and click "**Open**":



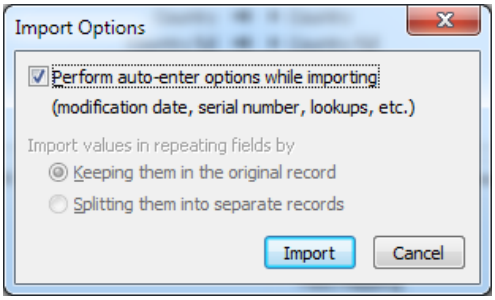
Note 1: This folder contains also the backup files with coordinates for the polygons for area services.

Note 2: The backup procedure may be replaced with just creating a full copy of Frequency Finder at regular intervals. For the runtime version the folder containing the runtime version should be copied.

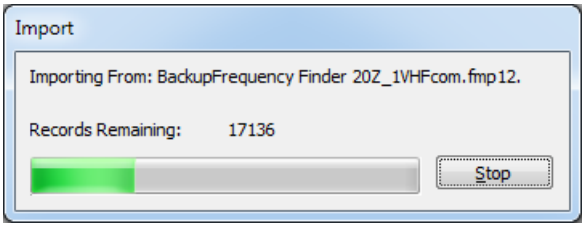


Make sure that in the next pop-up dialog box “Import Mapping” the drop-down menu “Arrange by” is set to “Matching Names”. The button **Import Action** needs to be set to “Add new records” . Click the button “Import” .

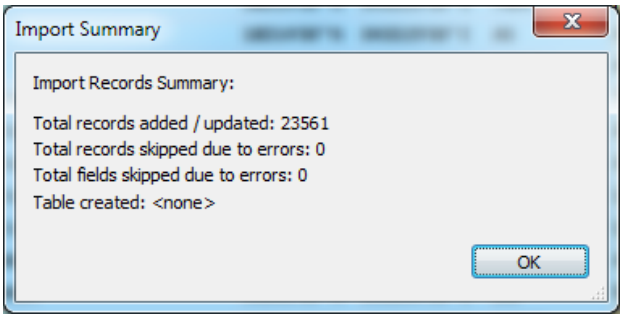
In the pop-up dialog “Import Options” click “Perform auto-enter options …” click the button **Import**.



The box “Import” shows the progress of the import of the database.



When the import of the back-up database is completed, the box “Import Summary” shows the import actions. Click “OK” to complete the import of the back-up database



IT IS STRONGLY RECOMMENDED TO MAKE REGULAR BACKUPs OF THE DATABASE!

3.5 Closing Frequency Finder.

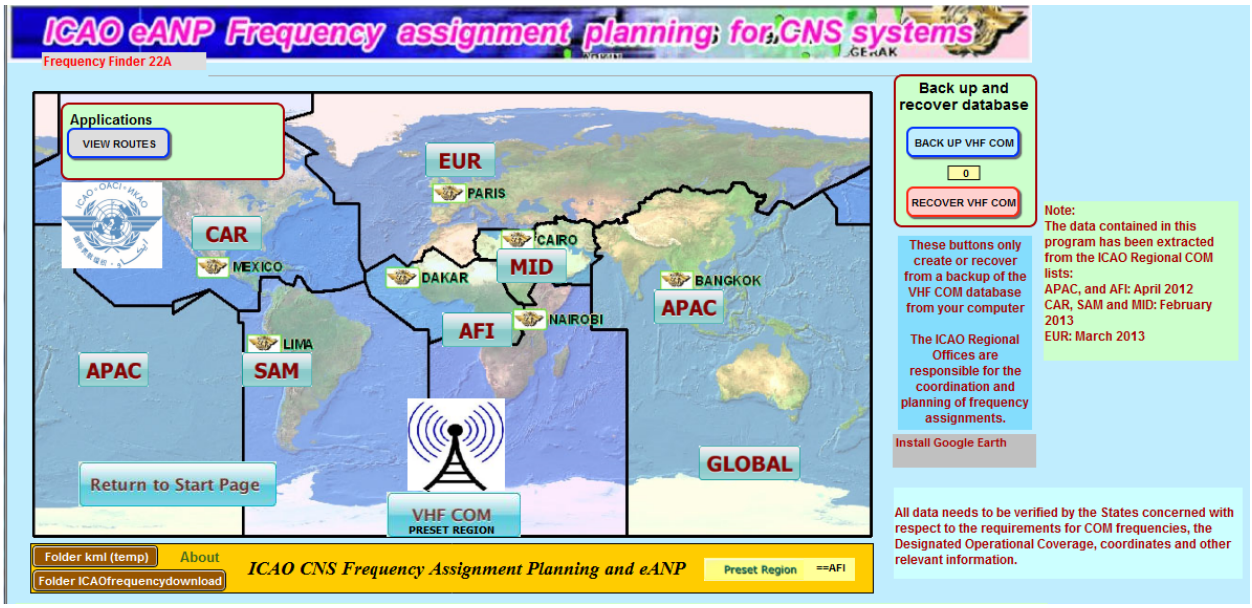
When closing Frequency Finder the user is invited through a popup dialog box to make a back-up copy of the data base of frequency assignments. Backup copies of the database of frequency assignments can also be generated at any time from the Start page or the Home page 9with the button "Backup VHF COM".

4 Frequency assignment planning for VHF air/ground communication systems

4.1 VHF COM Home Page

When clicking on the **Start Page** the button **VHF COM** 

the home page for managing VHF air/ground frequency assignments in the frequency band 117.975 – 137 opens:



4.1.1 The button returns the user to the **Start Page** of FF from where other databases can be accessed.

4.1.2 The 

buttons return the (Regional) list of VHF COM frequency assignments for only the selected Region.

The button 

returns the Global VHF COM Database (*i.e.* all frequency assignments for all Regions)

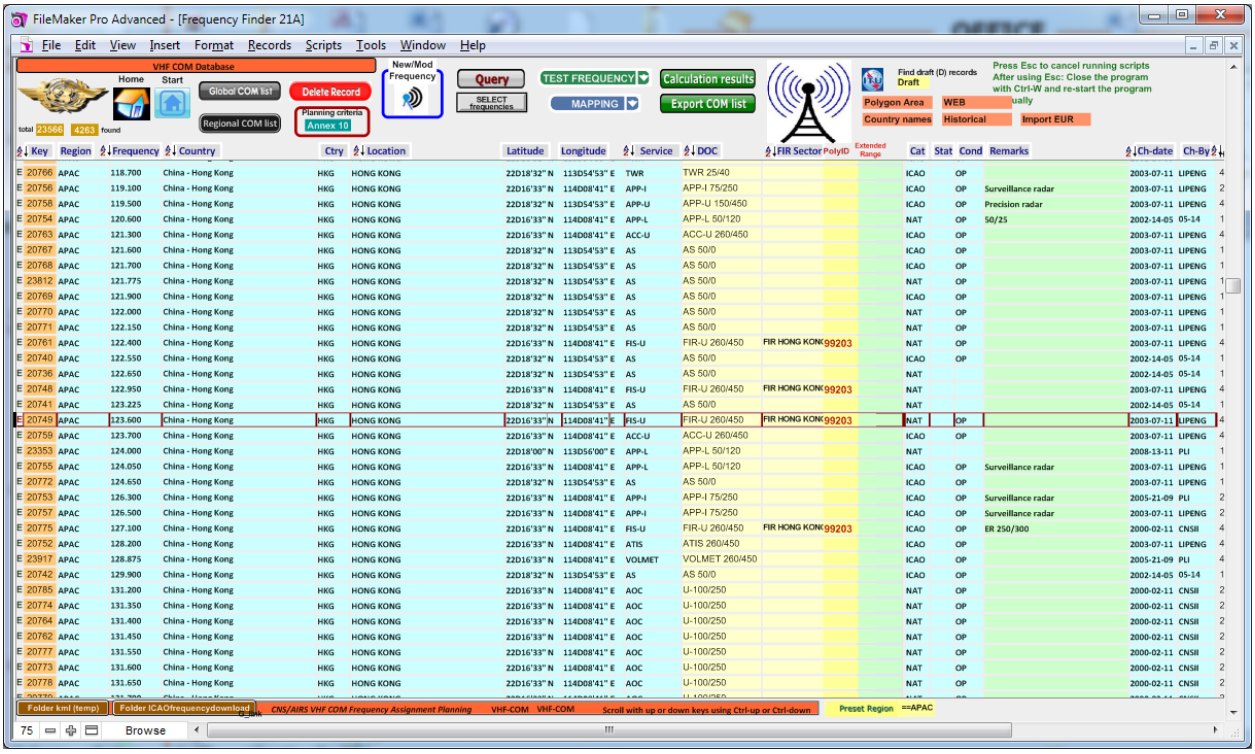
When one of these buttons is clicked, FF will open Google Earth and points to the location of the relevant Regional Office. Since FF generates the necessary files fast and in order to not lose information when using Google Earth, it is recommended to ensure that Google Earth is running prior to presenting the results of compatibility assessment of frequency assignments with Google Earth.

Note: When assessing compatibility of frequency assignments within one single Region, FF considers also compatibility with frequency assignments in other (adjacent) Regions and may trigger the need for interregional coordination for a particular frequency assignment.

The button VHF COM “preset region” returns either the Regional database in case a Region has been preset (as shown in the yellow bar at the bottom of this window) or returns the Global COM list in case no Region has been preset.

4.2 VHF COM data base

After clicking one of the buttons, the database window **VHF COM list** with frequency assignments for air/ground communication systems (voice and data) will open:



4.2.1 Data fields in the VHF COM list

The window **VHF COM database** is the main window for browsing the database with the VHF COM frequency assignment plan. The fields in this database which have a green background contain data that has been inserted from the current Regional COM lists. The general format of the Regional COM lists is maintained in presentation of the Global database of frequency assignments. The fields with a yellow background have been introduced by the ICAO Secretariat. These fields contain information which is necessary for FF to perform the necessary calculations and analyses. The values in these fields have been derived from the information contained in the regional ICAO COM lists.

The active record (which is the frequency assignment that is being browsed) is identified with a red bar in this window.

4.2.2 Content of the data fields in the VHF COM list

The VHF COM list includes the following information for each frequency assignment:

Key Unique Key for each frequency assignment

Region Region (Regional Office) responsible for coordination and registration of frequency

Frequency Frequency assignment (MHz) (or channel number for8.33 kHz frequency assignments)

133.355	Belgium
134.330	Belgium
128.200	Belgium
133.710	Belgium
120.915	Belgium
125.000	Belgium
128.800	Belgium
126.975	Belgium

25 kHz frequency assignments are shown with a light-green background

8.33 kHz frequency assignments are shown with a dark-green background

Country Country within which the frequency assignment is registered (ICAO country name)

Ctry ICAO abbreviation of country name

Location Location name of the station

Latitude Latitude of the station (DDMMSS)

Longitude Longitude of the station (DDDMMSS)

Service Service provided by the station

DOC Designated Operational Coverage of the station / service (See Appendix B for definition)

Cat Category (ICAO or NAT)

Stat Status (OP = operational; NOP = not operational)

Cond

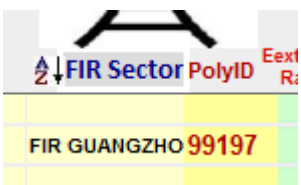
Remarks Condition – may be combined with Status)

Remarks pertinent to the frequency assignment or the station

Ch-date Date of entry or modification of the frequency assignment (format: YYYY-MM-DD)A

Ch-By Identification of who inserted the entry or modification (Frequency Finder adds the computer name in this field).

Allows for sorting in the order of various columns in the database



The data fields “FIR Sector and “PolyID” provide details on the area service that is associated with the frequency assignment. The data field “PolyID”

contains the number of the polygon which describes the (EUR) ACC or the (global) FIR sectors in the table PolyEUR. When an area service is defined through the polygon number, this whole of this area is considered for protection from harmful interference when assessing compatibility of the relevant frequency assignment. This method of frequency assignment planning, which improves efficient frequency assignment planning, disregards the real (typical circular) coverage that a ground station can provide. The identification of the area services that are being used in Europe have been imported from the EUR SAFIRE database and should not be changed in Frequency Finder. The user can associate any frequency assignment with a FIR sector or other polygon through the window New/Mod frequency (See § 4.7). A list with reference numbers for the FIR sectors is in Appendix G of this manual.

Note: The coordinates of the polygons for ACC and FIR sectors is contained in the table PolyEUR which can be accessed with the button Polygons Area on the toolbar of table COM List 3. This table is embedded in **FREQUENCY FINDER.** *Since the data (coordinates) for these areas is generated from outside and imported Frequency Finder and imported it should not be modified in Frequency Finder. Maintenance of the coordinates for area services can be introduced in Frequency Finder in case Regions (outside the EUR Region) should decide to implement the protection of frequency assignments throughout the relevant area service (typical ACC sectors).*

ER-TCD1 The name (coded) of an extended range (ER) network (column "Extended Range").

See also §4.6.1.4 and §4.7.3

Note: Stations that are identified as forming an extended range network are not tested for interference between each other. Proposals for the identification of ER networks in the COM list are [to be] developed with the (regional) implementation of **FREQUENCY FINDER.**

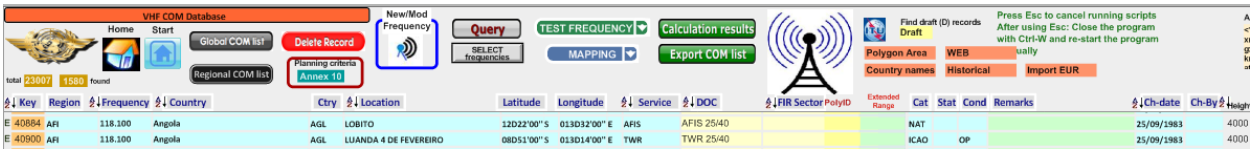
4.2.3 Buttons on the toolbar of Frequency Finder.

Various buttons on the toolbar perform the following main functions:

a. Query the database or manually select records (§4.3)
b. Enter a new frequency assignment or modify the characteristics of an existing frequency assignment (§4.7)
c. Test a frequency assignment for compatibility with other frequency assignments in the table (§4.6)
d. Plot the coverage of frequency assignments on the map (§4.5)
e. Export the table (or a selection of the table) in the format of the ICAO COM list 3 (§4.4)
f. Overlay air routes (See Chapter 9)
g. View calculation results (§4.6)
h. ITU – generation of T12 and T13 notices for registration in the ITU Master International Frequency Register (MIFR) (Appendix F)
i. Other buttons as specified below

These functions are explained in detail below, together with step-by-step examples.

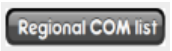
The toolbar for the VHF COM database includes the following buttons:



Buttons and functions supporting navigation through the VHF COM database and the various windows on the toolbar:

Navigation buttons: Home, Start, Global COM list, Regional COM list (§4.2.3.1)
Delete Record (§4.2.3.2)
Calculation results (§4.2.3.3)
Query and Select frequencies; Find temporary D records (§4.3)
Export COM list (§4.4)
Mapping: plotting coverage on the map) (§4.5)
Test Frequency (§4.6)
New/Mod frequency (§4.7)
Find temporary (draft) records / frequency assignments (§4.2.3.1)
ITU – generate T12 and T13 notices (for registration with the ITU Master International Frequency List, MIFR). (Appendix F; to be added)
Tables for:
Polygon Areas services (EUR Sectors and Global FIR; see Appendix G)
Country names, abbreviations and addresses (from ICAO Directory)
Historical data
Web database

4.2.3.1 Navigation buttons on the toolbar

With the button 

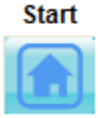
the database will return to the Regional VHF COM database of the Region that has been preset (see §3.4.6). In case no Region has been preset, this button will return the Regional COM list of the Region of the active (selected) record. The Global Database can always be viewed with the button 

The following buttons allow the user to navigate to the various windows or pages of FF.

Home

This button takes the user to the Home Page for VHF air/ground communications frequency assignments (see §4.1 for a description of the functions available on the Home Page).

Start

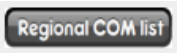


This button takes the user to the Start Page of FF. From this Start page, the user can navigate to the other modules of the program (see §3.4 for a description of the functions available on

the Start Page).

This button returns the Global Database with VHF COM frequency assignments. All about 25000 frequency assignments in the Global database can be browsed.

The button **Global COM list** always returns to the window **VHF COM Database** and presents all frequency assignments in the Global (VHF-COM) Database. This is the main window from where the various analyses that have been included in FF can be initiated. The record that was active on any window when the button **Global COM list** was clicked remains the active record when the Global Database (VHF COM list) is shown.

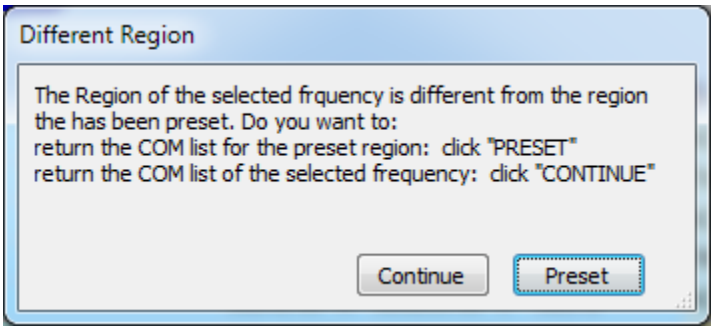


This button returns the Regional Database on the window **VHF COM database**.

In case no Region has been preset (the field "F**requency Finder has been preset to**" at the bottom of the VHF COM data base window is empty), this button returns the Regional COM list of the Region of the active record (frequency assignment).

However, in case a Region has been preset, the following applies:

1. The active record is in the same Region as the Preset Region. In this case the button **Regional COM list** returns all records for that Region.
2. The active record is outside the preset Region. In this case a pop-up dialog box offers the user to either
    a. Return all records for the Preset Region
    b. Return all records for the Region of the active record



The frequency assignments for a single Region can be browsed when the button **Regional COM list** is clicked. To facilitate navigation through the different windows FF tries to return to the frequency assignment that has been selected (or is active) in any other window when returning to the VHF COM database..

The buttons **Global COM list** and **Regional COM list** are placed on various windows of FF and return the user to the window **VHF COM database**.

4.2.3.2 Delete record

The button 

deletes the selected frequency assignment from the VHF COM database. This button also deletes occurrences of the selected frequency assignment in the window **Summary Calculations**.(See §4.6.3).

Records (frequency assignments) that have been deleted with the button "Delete Record" are saved in the table "Historical" for future auditing.

4.2.3.3 Calculation results

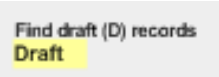
The button 

navigates the user to the page **Summary Calculations**. On this page the saved summary of tests (calculation results) can be viewed. From this page it is also possible to navigate to the pages with detailed test results of the co-frequency and adjacent frequency calculations of the most recent calculation. Earlier calculations, of which the summary is saved on this page, can be re-started from this page. (See § 4.6.3 for more details on the page Summary Calculations.)

Note: When returning from the window "Calculation results" Frequency Finder returns to the Region and the frequency of the active record.

4.3 Finding frequency assignments (Buttons Query, SELECT frequencies and Find temporary (D) records)

4.3.1 Find temporary (D) records.



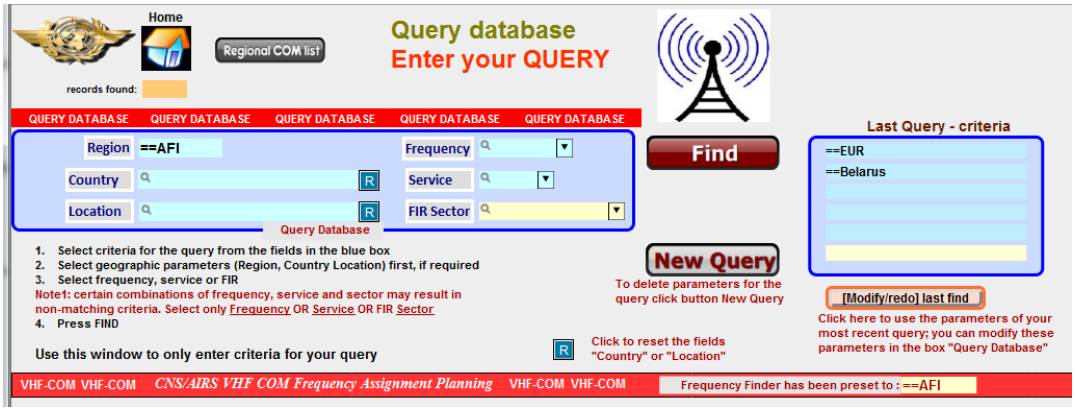
The button "**Draft**" finds all temporary or draft frequency assignments in the Global Database. This button has been introduced to facilitate a search for temporary or draft frequency assignments. An example of a draft frequency assignment is when a new (or modified) frequency assignment has been found compatible with the database of frequency assignments and this frequency assignment is kept in the database while beings subject to coordination with States that may be affected by this frequency assignment. The new (or modified) ***draft*** frequency assignment can be kept in the database until such time when the new (or modified) frequency assignment becomes permanent (e.g. after the coordination procedure is successfully completed). Compatibility assessment of other (e.g. new or modified) frequency assignments will take into consideration the need to protect the draft frequency assignment from harmful interference. The creation and use of temporary or draft frequency assignments is further described in §4.7 below.

4.3.2 Query

4.3.2.1 Start the Query

The button 

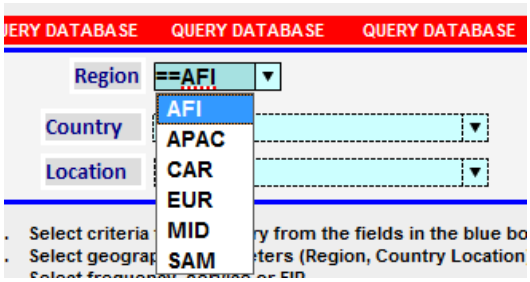
on the page" VHF COM Database" starts the process of querying the database. Clicking this button will open the window **Query database**:



The data base can be queried using the following criteria:

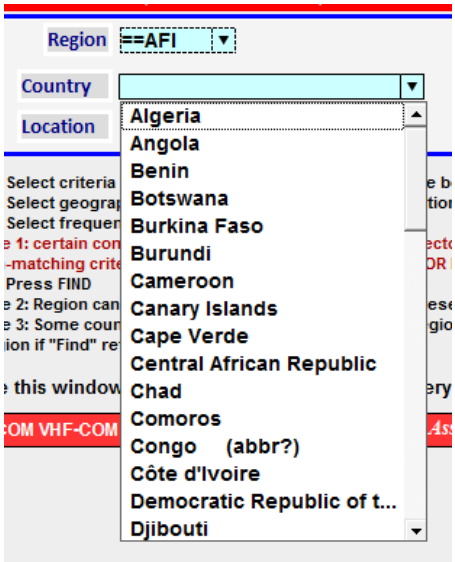
Region

In the example, since the Region was pre-set to AFI, the field **Region** is already filled when the "Query" page opens. However, irrespective if a Region has been pre-set or not, the user can query the database for frequency assignments for each Region. If the field **Region** is clicked, the user can select a Region from a drop-down menu:



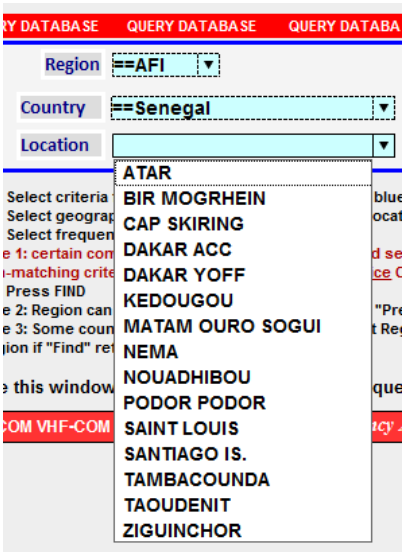
Country

When a Region has been selected, click the field **Country** to show a drop-down menu which lists all countries within that Region:

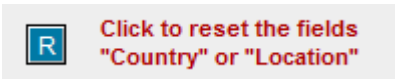


Location

When a Region and a country have been selected, click the field **Location to** show a drop-down menu which lists all locations in that country:



Note: Should a user attempt to enter a Country name without having entered a Region or attempt to enter a Location name without having entered a Region and Country name, the pop-up box "No Region and/or country name selected" will inform the user that the selection of the parameters for the query needs to be updated before selecting a country or a location:



The button "**R**" can be used to reset the choice (selection) for a country or a Location. Using this button also resets any choice in the fields Frequency, Service or FIR Sector.

*Note: See §4.3.2.6 for entering the query parameters **Frequency, Service** and **FIR Sector**.*

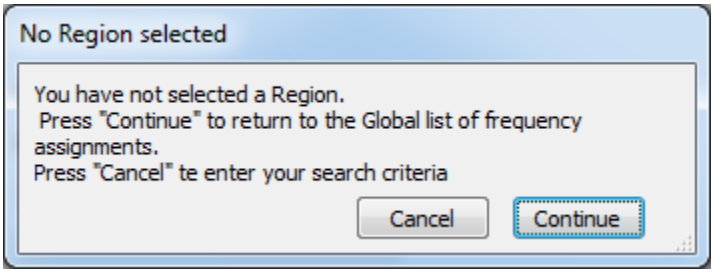
4.3.2.2 Perform Find

To execute the Query click the button 

It is not necessary to enter all available parameters in a query. For example, a query for AFI/Kenya will return all frequency assignments in Kenya and a query for AFI/118.100 MHz will return all frequency assignments for 118.100 MHz in the AFI Region.

However, a country name cannot be selected without first having selected a Region and a location name cannot be selected without first having selected a Region *and* a country. Clicking the button **Find** will return to the window VHF COM database and shows only those frequency assignments that satisfy the parameters of the query.

Clicking the button **Find** *without* having selected a **Region** will return a pop-up menu, informing the user that no Region has been selected:



The button “Continue” on this pop-up menu returns the global data base of frequency assignments. The button “Cancel” will take no action and the user can insert the required search criteria. As a minimum, a Region needs to be selected.

Note: When a Region is preset, the field “Region” on the Query page displays the name of the Region that has been preset. The user can in any case select any Region to search for frequency assignments in other Regions.

4.3.2.3 Using the criteria for a query (examples):

Click the button **Find** after having selected a **Region** to return the all frequency assignments for that Region which are in the VHF COM database. The results of this query are the same as when clicking the button “**Regional COM list**” (see §4.2.3.1).

Examples:
(i) After having entered in the field **Region** the Region name AFI, **FIND** returns all frequency assignments [1700+] in the Global database for the AFI Region.

(ii) After having entered in the field **Region** the Region name AFI and in the field **Country** the country name Senegal**, FIND** returns all frequency assignments registered for Senegal.

Note 1: In order to find all frequency assignments for a selected country it is necessary that the name of the country is consistent throughout the Global database. The use of the official ICAO country names and abbreviations, as contained in the ICAO Directory (re. Appendix A) is implemented and secures compatibility with other ICAO databases (e.g. for FIR Sectors, air routes, way points and 5 letter name codes).

Note 2: In a number of cases Country names and frequency assignments are listed in more than one Regional COM list (E.g. Morocco, Algeria and Tunisia are listed both in the EUR Region and the AFI Region). This results in double entries of the same frequency assignment in the Global Database. Regional Offices should coordinate which countries and frequency assignments are to be listed within their Region and avoid listing of the same frequency assignment in more than one Regional COM list. The use of the (single) Global Database in Frequency Finder ensures that interregional compatibility of frequency assignments is being assessed. In cases where frequency assignments in adjacent Regions are involved in the compatibility calculations, interregional coordination needs to be triggered between the relevant Regional Offices. This issue is currently being addressed in coordination with the relevant Regions.

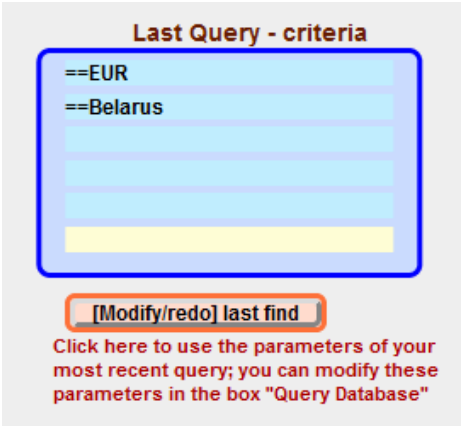
4.3.2.4 New Query

The button 

can be used to modify the parameters for a query. Using this button will empty all fields in the query and the user can enter a new query. If the selection of a Region has been pre-set to a particular Region (see § 3.4.6), the name of that (preset) Region will be shown as "==Region" (e.g. ==AFI) in the field **Region**. However, through clicking in the field **Region**, the user can, from the drop-down menu, select any other Region for the query.

4.3.2.5 Last Query - criteria

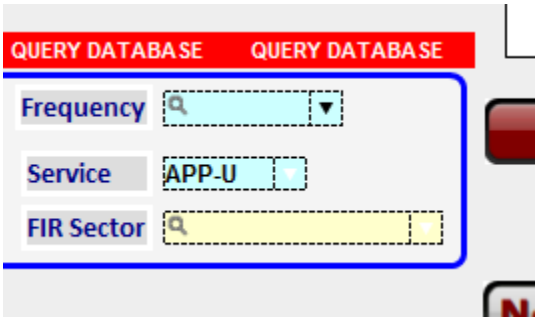
FF saves the parameters that were used in the most recent query. This has been introduced to facilitate re-doing a query. These parameters are saved in the following box:



Click the button **[Modify/redo] last find** to place the parameters of the most recent query in the relevant "Query" fields in the blue box on the window **Query database** (See §4.3.2.1). The parameters for the query can be updated and, with the button **FIND**, the query can be performed.

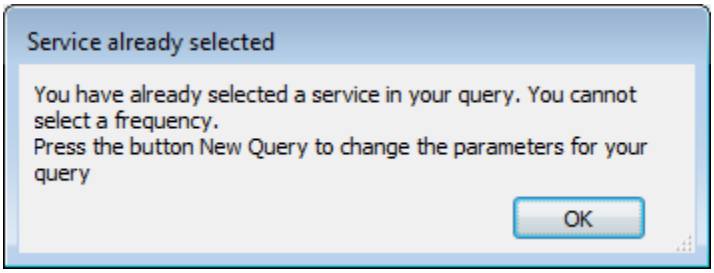
4.3.2.6 Query for frequency, service or FIR sector

The user can also search for a particular frequency, service or FIR sector in the Global Database with the fields:

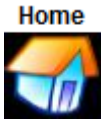


Clicking in one of the **fields Frequency, Service** or **FIR Sector** shows, in a drop down menu, the frequencies, services or FIR sectors that can be selected. The selection offered in the drop-down menu is consistent with the selection of **Region**, **Region-Country** and **Region-Country-Location**. Only frequencies, services or FIR sectors that are in use within a Region, within a country or at the selected location are shown in the drop-down menu.

These parameters are mutually exclusive. If one parameter (Frequency, Service or FIR Sector) has been selected, each of the two other parameters cannot longer be selected. If the user still attempts to enter a second parameter, a pop-up menu gives a warning as follows:



Example: If a Service has already been selected, as shown in the pop-up dialog box above, the user cannot select a frequency or FIR Sector.

The button 

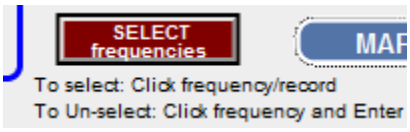
on the window "Query" cancels the query and returns to the Home Page of the module for VHF air/ground frequency assignments.

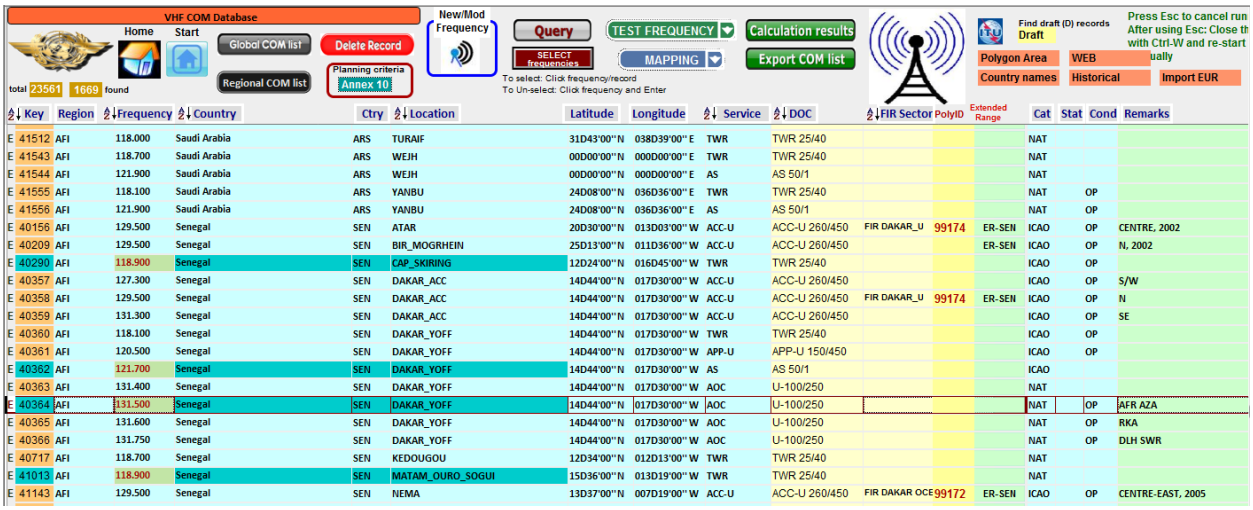
The button Regional COM list cancels the query and returns to the active record (the selected frequency assignment) of the VHF COM database at the time the query was initiated and the Regional database for that Region.

4.3.3 Select frequencies (manually)

The option to select (manually) one or more frequencies has been introduced in FF. To select manually a group of frequency assignments (or a single frequency assignment) from the VHF COM database the button SELECT frequencies should be clicked.

When this button is clicked, the background color turns red and the background color of the active or selected frequency assignment in the table changes to dark green to indicate the [first] selected frequency assignment.



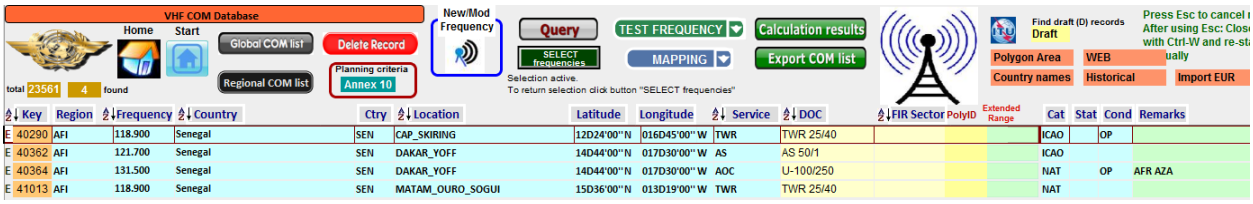


Other frequency assignments can now be added to the selection manually. When clicking other frequency assignments, the background color of these frequency assignments also turns dark-green indicating that these are added to the selection.

A frequency assignment (record) can be un-selected by clicking the record followed by “Enter” from your keyboard.

When the user has completed the (manual) selection of frequency assignments, the button “SELECT frequencies” can be clicked again and turns into green background color. The green color indicates that the parameters of a selection or query are present.

The VHF COM database now shows only the selected frequency assignments:

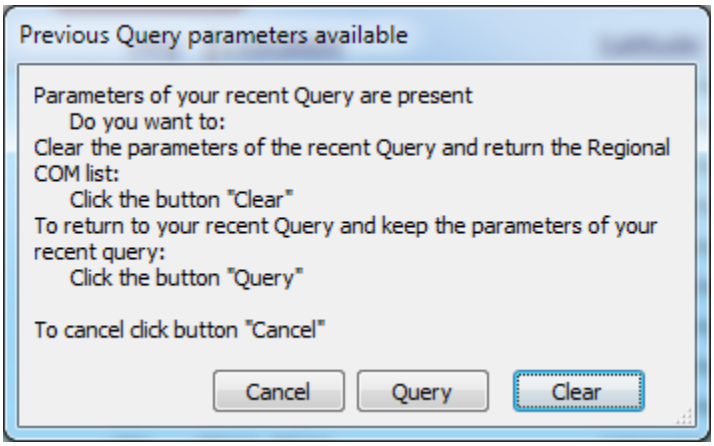


Note: The parameters for the most recent query through either the window "Query" as described in §4.3.2.1 or the "manual" selection of frequency assignments as described in §4.3.3 are saved. At any time the user can return the find results of the query with the button "SELECT frequencies".

The user can return the recent query by clicking the (green) button SELECT frequencies. Also, the parameters of the query or the manual selection can be removed by clicking the (green) button SELECT frequencies again at any time so desired. In this process, various pop-up menus guide the user to the various options that are provided in the program. These options are:

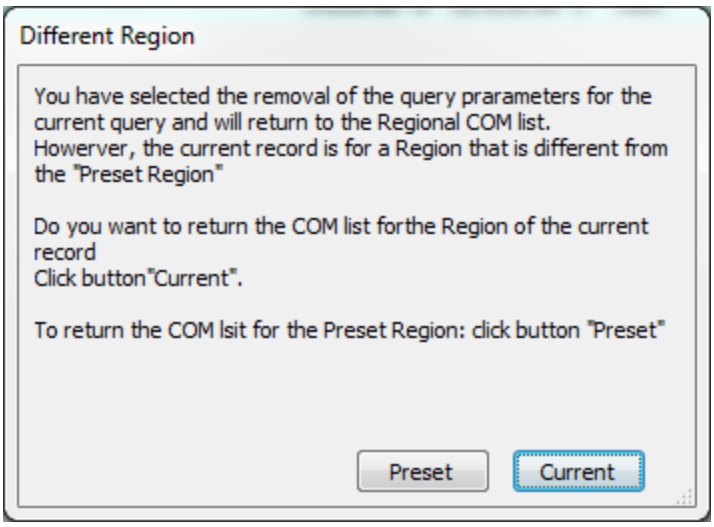
a. to remove the parameters of the query/selection and return to the Regional COM list.
b. keep the parameters of the query/selection and return the last query
c. cancel (the process of) removing the parameters of the recent query/selection

The pop-up menu "*Previous Query parameters available*" provides for these options:



When the button "Query" is selected, the most recent query will be executed.

When the button "Clear" is selected, the parameters for the query are removed and the Regional COM list will be returned. However, when in this case the active record (selected frequency) is outside the Region that has been preset, the user will have the option to either return the Regional COM list of the active record or the Regional COM list of the Preset Region through the popup dialog box:



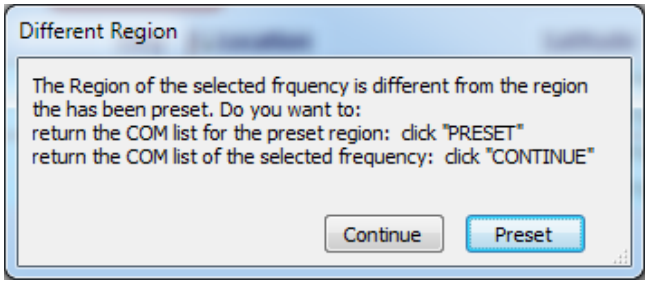
When the parameters of the recent query or selection are removed, the button **"SELECT frequencies"** on the toolbar of the COM list turns into the gray color.

Note: the option to return to either the desired Regional COM list or to the recent Query/Selection of frequency assignments facilitates the navigation through the various pages of the program and, as desired, to return the query/selection without having to re-enter the parameters of the query/selection.

*Note: The button **"SELECT frequencies"** also turns into green when a query has been made with the button **"QUERY"** (see paragraph 4.3.2.1)*

4.3.4 This selected group of frequency assignments can (as a result of a query or a selection), similar to any other group of frequency assignments that is the result of a query, be further considered for mapping (plot the coverage on a map), for testing the compatibility of these frequency assignments with the VHF COM database or for exporting in the format of the ICAO COM list 3. Mapping, testing or exporting of a group of frequency assignments is addressed in the relevant paragraphs below.

Note: In case the selection includes frequency assignments from more than one Region, FF returns to the Regional COM list of the active or selected frequency assignment or to the Regional COM list of the Region that has been preset. The user can select the list to return to through the pop-up menu :Different Region":



4.4 Export COM list

4.4.1 Initiate Export COM list

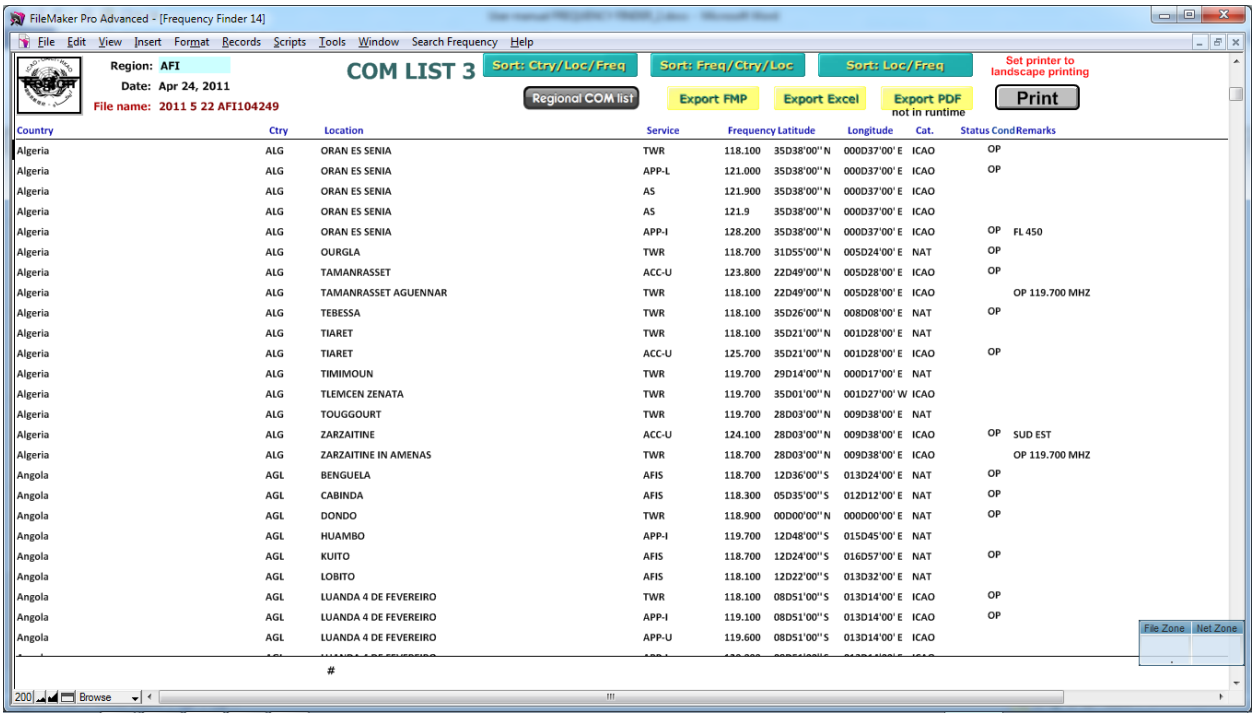
The frequency assignments in the Global Database, or the selected Regional Database or any other selection of frequency assignments (e.g. as a result of a query) can be exported in the format of the ICAO COM list. Exporting the selected frequency assignments starts with the button Export COM list

The list that can be exported in the format of the ICAO COM list is the listing of frequency assignments as per result of a query or selection of frequency assignments. Normally this is the list of frequency assignments for a Region (Query only the Region). However, the user can create its own list of frequency assignments in the format of the ICAO COM list.

Click the button Export COM list to open a new window which contains the essential characteristics of the (selected) frequency assignments in the format of the regular ICAO COM lists

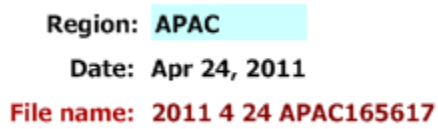
Some information in the window “VHF COM database” and which is normally (currently) not included in the ICAO COM list has been omitted from the export (such as the DOC, Extended Range or the FIR Sector).

Note: It is the intention that this information will be incorporated in the future ICAO COM lists



4.4.2 Toolbar for Export COM list

The toolbar for the window **Export COM list** provides the following information and functionality:



Region: This field contains the name of the Region.
Note: When the list includes frequency assignments from more than one Region, this field contains the Region of the active or selected frequency assignment.

Date: This field contains the date when the (exported) VHF COM list was created with FF

File name: This field contains the filename of the COM list that is (being) exported. The filename includes the date of the creation of the VHF COM list, the Region name and a time stamp, in order to create a unique filename.

4.4.2.1 Export COM list – Toolbar (buttons)

The button 

returns to the main window of the VHF COM database (or a Regional or local sub-set of this database) and with selection of frequency assignments at the time when the exported VHF COM list was created.

The buttons 

enable the user to sort the list prior to export. The list can be sorted in the following order:

1. Country – Location – Frequency
2. Frequency – Country – Location
3. Location – Frequency

Note: If desired, other sorting orders can be included.

4.4.3 File format for the COM list (exported)

The VHF COM database can be exported in the following file formats:

1. FileMaker Pro 12
2. Microsoft Office – Excel
3. Adobe PDF

Note: export in Adobe PDF format is only available with the full version of FF that runs with FileMaker Pro.

Export FMP Clicking this button exports the COM list in the format of FileMaker Pro. The files are saved in the folder **ICAOfrequencydownload/SaveFMP** which is located on the C:/ drive.

Export Excel Clicking this button exports the COM list as a Microsoft Excel file. The file is saved in the folder **ICAOfrequencydownload/SaveExcel** on the C:/ drive of your computer.

Export PDF Clicking this button exports the COM list in the format of and Adobe PDF file. This file is saved in the folder **ICAOfrequencydownload/SavePDF** on the C:/ drive of your computer.

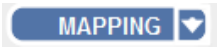
After the files with the essential data of the COM list has been created, Frequency Finder will open these files for verification by the users. The folders where these files are placed can later be accessed with the button “Folder ICAOfrequencydownload” that is located on several windows of Frequency Finder or by navigation on your computer to the folder “ICAOfrequencydownload” on the C:/ drive of your computer.

4.4.4 Printing the COM list (exported).

4.3.2.6.1 With the button Print the VHF COM list can be printed. Before printing, make sure the printer is set to printing in landscape format.
Check if also the fields PolyID are printed; if necessary change zoom level

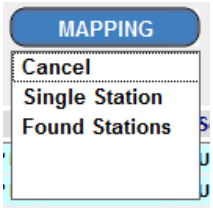
4.5 Mapping.

4.5.1 Initiate mapping

The button 

enables plotting of the Designated Operational Coverage (DOC) of the frequency assignment on the map. The DOC can have the format of a circle

When clicking the button **Mapping**, a drop-down menu presents the following options:



i. **Cancel** -cancels the mapping (e.g. in case this button was clicked inadvertently).

ii. **Single station** -plots the Designated Operational Coverage of the selected frequency assignment is on the map with Google Earth.

iii. **Found stations** -plots the Designated Operational Coverage of the selection of frequency assignments on the map with Google Earth

*Note: Selecting **Found stations** with a large number of frequency assignments on the window **VHF COM database** will plot the coverage of all found frequency assignments on the map. This may take time and the results may not be easy to be interpreted. The process for mapping can be cancelled by pressing the **Esc** button on the keyboard as follows:*

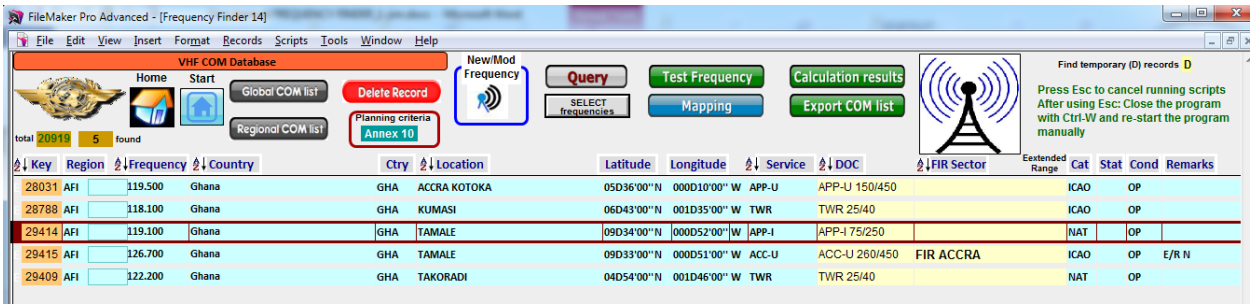
Reduce the size of the Google Earth window (if maximized).

Click on the window VHF COM database to make this the active window and click Esc on the keyboard; this may need to be repeated several times.

4.5.2 Mapping Single station

4.5.2.1 Click **Single station** from the drop down menu to trigger the creation of a file for displaying the DOC of the selected (active, single) station on the map. Currently, this file is a kml file which is specific for use with Google Earth.

In the example below, the frequency 119.100 MHz, APP-I, at Tamale, Ghana, has been selected for mapping the coverage.



4.5.2.2 FF has, when importing the database of frequency assignments for each Region, already calculated the DOC and placed in the column DOC in the format Service Range/Height (e.g. APP-I 75/250) on the window COM List 3.

4.5.2.2.1 The range and the height are taken from Table B – 1 in Appendix B in this manual which contains the description of the (regionally agreed) uniform values for the DOC. Alternatively, in case in the Regional COM list a non-uniform DOC has been identified, any non-uniform DOC can be used and inserted in the database as described in §4.7.3.1). The table of uniform values for the DOC in Appendix B includes uniform values for Designated Operational Range and Designated Operational Height.

Note: the table of uniform values for the Designated Operational Coverage has been incorporated in the ICAO Handbook on Radio Frequency Spectrum Requirements, Volume II (Doc. 9718). This information was taken from material in the Regional Air Navigation Plans.

4.5.2.2.2 For area services, like ACC and FIR, in the absence of a defined or specified area, the range used in FF is the maximum (circular) distance (to the radio horizon) for the height specified in Appendix B. In case the frequency assignment is related to an area service (ACC, FIS) the presentation of the coverage on the map includes the relevant area of this service as well. (See § 4.5.2.5 for more information).

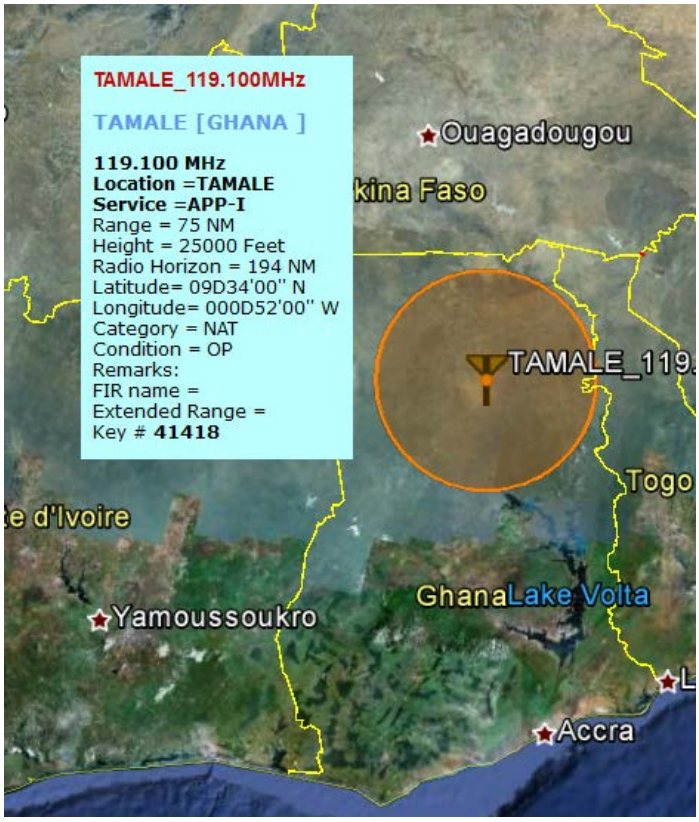
Example: For ACC-U, the distance to the radio horizon at the maximum flight level 450 (45000 ft) is 260 NM, while for ACC-L the maximum flight level is 250 NM, which results in the distance to the radio horizon of 193 NM. These distances are used in FF as appropriate for the Designated Operational Range although in practice, due to the lobing of the antenna diagram at vary low angles the actual operational coverage may be (significantly) less than 80% of the distance to the radio horizon..

4.5.2.2.3 It is recommended to use non-standard DOC where possible which allows for tailoring the DOC to actual operational requirements. FF includes provisions to insert non-standard DOC values (see §4.7.3.1). This method may make frequency assignment planning more efficient.

4.5.2.3 FF continues with calculating (real time) the coordinates of the contours of the DOC and merges these with other data (such as Region, Country, Location, Frequency etc.) from the selected frequency assignment in a .kml file (Keyhole Markup Language) which is used by Google Earth

to plot the data (coverage) on the map. When a .kml file is created, it is stored in a temporary folder that has been created by FileMaker Pro when starting FF. (See §3.2).

4.5.2.4 After creation of the kml file, FF opens this file which in turn triggers Google Earth to open. The example below shows for Tamale APP/I the coverage on the map as follows:



When clicking on the icon for Tamale on the map, Google Earth will display a balloon containing data which is pertinent to the frequency assignment. For the presentation of the coverage on the map with Google Earth, the location icon and the circles or polygons describing the coverage (DOC – Range) are both orange.

4.5.2.4.1 When presenting on the map the geographical data, the following scheme is used:

Coverage (border) : orange line (circle or polygon); the cirle or polgon is filled with orange (transparent)

Icon: 

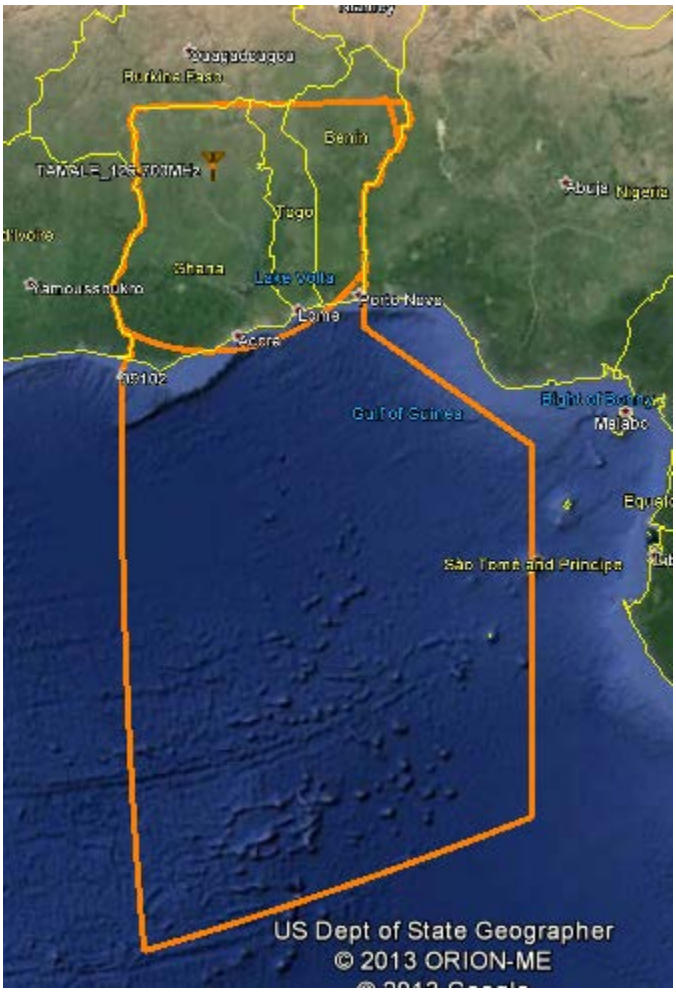
Check color with map where colors are OK

4.5.2.5 In a number of cases, frequencies registered with ICAO to provide an area service (ACC, FIS) and are actually linked to one (or more) areas as defined in the table PolyEUR (See App. G). When this is the case, Frequency Finder presents the area service and the coverage of the related frequency assignment or station.

For area services, the DOC is limited to the area served and protection from harmful interference is only required within these areas. In many cases however actual coverage of a frequency assignment can extend to outside the DOC, without actually being used (outside the DOC).

Although frequency assignments for area services are to operate "*within the specified area"* (see Appendix B), in most Regions the relevant area is not specified. In these cases, where the area is not specified, a protected coverage up to the radio horizon for the specified (maximum) height of the area is assumed (and used in current frequency assignment planning in these Regions), even if this results in a "coverage" outside the DOC of the area service.

In the example below, the coverage of the frequency 126.700 MHz, in use at Tamale in Ghana to service FIR Accra is shown with FF on the map with Google Earth as follows:



FF plots on the map the FIR sector (FIR Accra) as well as the coverage of the relevant frequency or radio station providing FIS but only *within* the identified FIR.
In the example shown in the figure above, the (frequency protected) coverage for Tamale ACC-U (this station is assumed to provide also FIS) is up to a range of 260 NM. In the directions between South-West – North – South-East the range to the boundary of the FIR from Tamale is less than 260 NM. The frequency protected coverage in these directions is therefore limited to the boundaries of the FIR Accra. No frequency protection is required outside the FIR.

Note: This feature has been introduced for consideration by the users/Regional Offices and can be expanded to include ACC Sectors as well in future additions. The identification of any such FIR sectors or ACC sectors as presented in the current version needs to be confirmed by States. The effect is more efficient frequency assignment planning since frequency assignments do not require frequency protection outside the DOC.

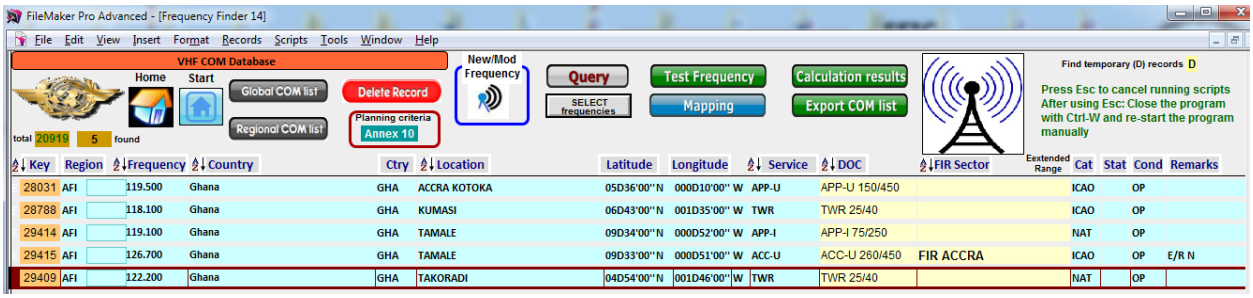
In case NO area service (FIR) has been identified for an frequency assignment providing FIS (Flight Information Service), the coverage is mapped with Frequency Finder as follows:

Note that in this case the coverage (which is also the protected coverage) for Tamale ACC extends to well outside the FIR ACCRA.

4.5.3 Mapping Found Stations

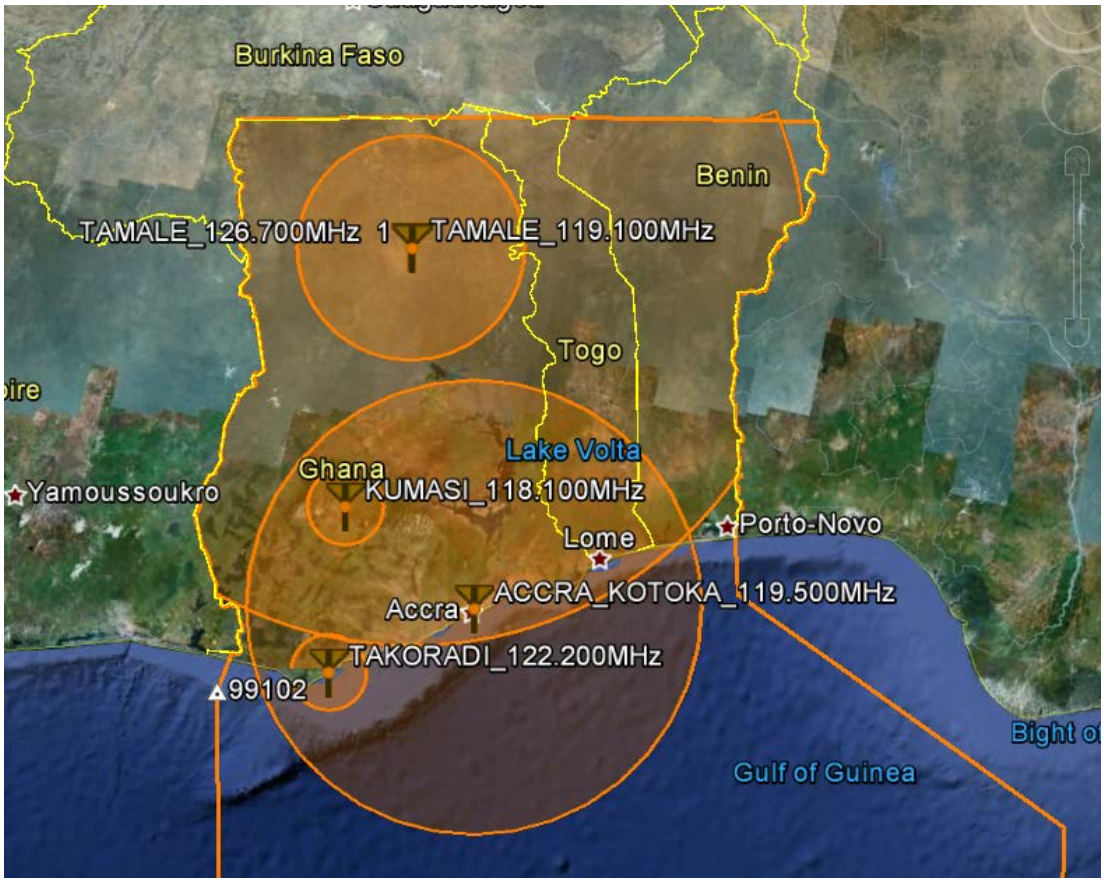
4.5.3.1 Click **Found Stations** from the drop down menu (§4.5.1) to trigger the processes for displaying the DOC of all of the selected stations on the map.

In the example below, 5 frequency assignments in Ghana have been selected to be plotted on the map:



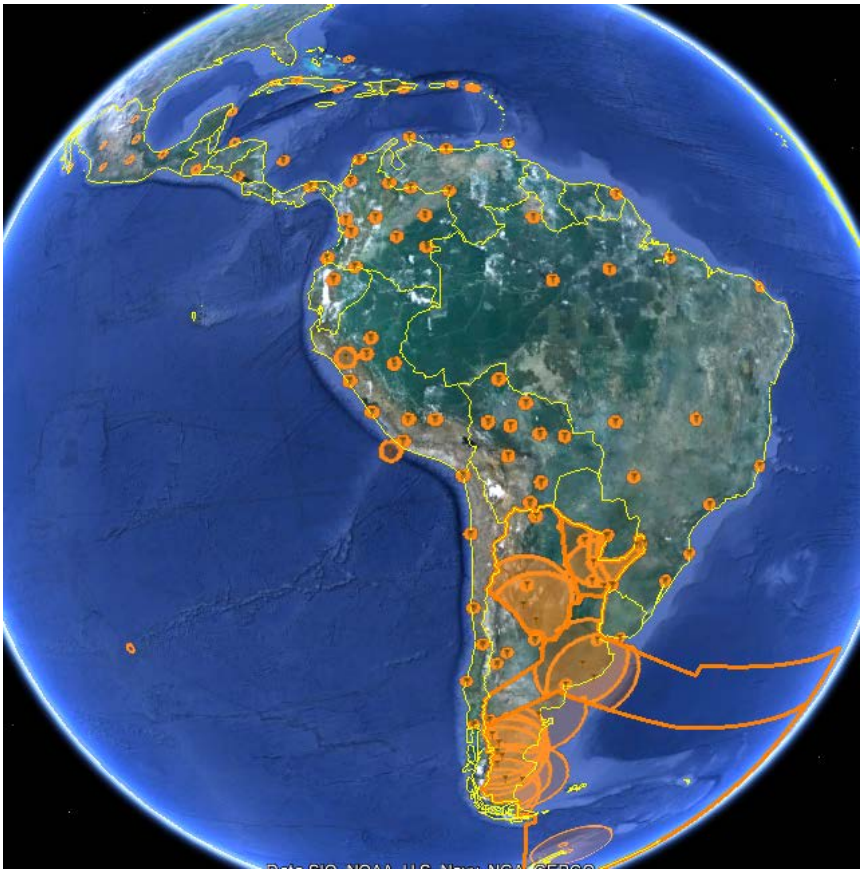
When clicking the button **Mapping** and from the drop-down menu **Found Stations**, FF starts creating for each frequency assignment a single kml file that plots the characteristics of that frequency assignment on the map with Google Earth.

The result is the mapping of these frequency assignments as below:



The map shows the coverage (Designated Operational Coverage) for:
Tamale ACC-U (providing FIS service within FIR Accra)
Tamale APP-I
Kumasi TWR
Accra Kotoka APP-U
Takoradi TWR

4.5.3.2 As another example, the following figure shows the coverage of all frequency assignments on the frequency 118.100 MHz in the CAR and the SAM Regions:



Example: The map for the CAR and the SAM Regions (above) has been created as follows:

A. In accordance with the instructions for querying the database in 4.3.2, the VHF COM database was queried with the following parameters

Click button **Query** on the window VHF COM data base(to go window “Query database”: On the Query window select:

Region: select CAR from the drop-down menu

Frequency: select 118.100 from the drop-down menu

Click button “**Find**”

The window COM List 3 (VHF COM database) returns all frequency assignments on the frequency 118.100 MHz in the CAR Region

Click the button **Mapping** and select from the drop-down menu **Found Stations.**

After all found frequencies in the CAR Region on the frequency 118.100 MHz have been plotted on the map, click the button “**Query**” (to query again the database in Frequency Finder)

On the Query window select:

Region: select SAM from the drop-down menu
Frequency: select 118.100 from the drop-down menu
Click button "**Find**"

The window COM List 3 returns all frequency assignments on the frequency 118.100 MHz in the SAM Region.

Click the button **Mapping** and select from the drop-down menu **Found Stations** to plot the DOC for the found frequency assignments on the map.

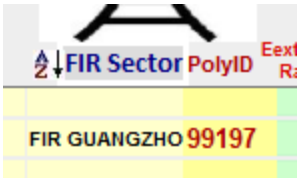
The calculations for generating the files for plotting the data on the map with Google Earth are taking place on a real time basis or "on the fly" (with the exception of the coverage of polygons for area services). In this manner, always the most recent data is used for the mapping.

4.5.4 FIR Sectors.

The coordinates for the FIR sectors have been imported from the ICAO program ICAOFIR12 and are embedded in the table PolyEUR in Frequency Finder. This table is described in Appendix G. The table PolyEUR can be accessed with the button "**Polygon Areas**" Polygon Area on the window VHF COM database (COM List 3).

The data for this table is imported from the European database "SAFIRE" (EUR polygons) and the program ICAOFIR [*XX*] (FIR sectors).

From time to time, this table needs to be updated. Appendix G explains the procedure for updating the table PolyEUR. In the column/field "**FIR Sector"** in the window VHF COM database the user can introduce or change the relation between the frequency and the area service as described in §4.7.3. The polygon data itself (coordinates) should not be modified through Frequency Finder. For the FIR (only) sectors, a table with the PolyID numbers is in Appendix G to facilitate identification of FIR sectors in Frequency Finder. See also §4.2.2 for a description and the use of the fields FIR Sector and PolyID



The procedure to follow in order to link a frequency assignment with an FIR sector is described in §4.7.3. When a frequency assignment is linked to an FIR sector, Frequency Finder calculates the necessary protection throughout that FIR sector, rather than protection only for the (circular) coverage of the ground station. This method would also enable (future) introduction of Extended Range facilities, operating on the same nominal frequency, to improve coverage VHF coverage of the FIR sector. The introduction of such new extended range facilities would not require renewed frequency coordination.

4.6 Testing of frequency assignments and viewing the calculation results

Any frequency assignment in the VHF COM database can be tested for compatibility with all other frequency assignments which have been entered in the database. Frequency Finder automatically tests separation distances for 25 kHz channel spacing, for 8.33 KHz channel spacing and for frequency assignments operating in a mixed 25 / 8.33 kHz environment.

4.6.1 Initiating the testing of frequency assignments.

4.6.1.1 Frequency assignment planning criteria

In previous version of Frequency Finder it was possible to select for compatibility calculations the criteria used with the provisions of Annex 10 or those that were agreed on a Regional basis. This option has been disabled since it was agreed that all Regions would apply (in the near future) the planning criteria as per Annex 10 and the ICAO *"Handbook on Radio Frequency Spectrum Requirements",* Vol. II, "*Frequency assignment planning criteria for aeronautical radio communication and navigation systems" which was published by ICAO in 2013.*

The field "Planning criteria" no simply identifies that throughout Frequency Finder the planning criteria as per Annex 10 are applied.

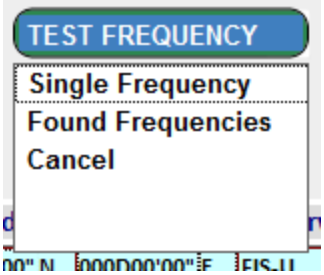
4.6.1.1.1. The frequency assignment planning criteria as specified in Annex 10 ensure that the geographical separation (co-frequency) between an interferer (transmitter, either ground based or aircraft based) and a victim (receiver; either ground based or aircraft based) is greater than the distance to the radio horizon.

4.6.1.1.2 The geographical separation distances for services with uniform designated operational coverage as contained in Appendix B, are in Appendix C. The actual required minimum geographical separation distance (e.g. in case non-uniform DOC values are to be used) are calculated with Frequency Finder on a real-time basis during the testing.

4.6.1.2 Test single or multiple frequency assignments

When clicking the 

button, a drop-down list offers the user the following options:



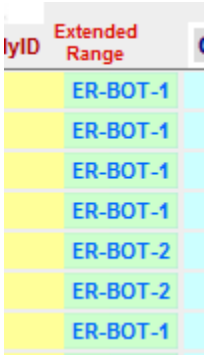
i. **Single Frequency** -to test only the selected frequency assignment
ii. **Found Frequencies** -to test the selection of frequency assignments
iii. **Cancel** -to cancel the testing (e.g. in case this button was clicked inadvertently).

4.6.1.2.1 When performing the compatibility tests, the program FF identifies all frequency assignments that can possibly interfere with the selected radio station (and vice versa) and calculates for each frequency assignment whether the frequency assignment planning criteria are satisfied. Details on the minimum separation distances required to avoid harmful interference are in the ICAO *Handbook on radio frequency spectrum requirements*, Volume II, *Frequency assignment planning criteria for aeronautical radio communication and navigation systems* (Doc. 9718).

Note: FF considers ALL co-frequency assignments within the range of at least 1050 NM from location of the selected frequency assignment as potential interferer (and, vice versa, as victim), including frequency assignments that are operating in an extended range (climax or off-set carrier system) configuration and/or are operating in adjacent Regions. FF summarizes however frequency assignments operating in an extended range configuration as non-interfering between each other. Extended range facilities assignments typically operate on the same frequency and with overlapping coverage areas.

4.6.1.3 When initiating the testing of a *SINGLE* frequency, the user is invited, through pop-up dialog boxes, to plot the coverage and interference areas, if any, to visualize co-frequency and adjacent frequency compatibility on the map. This is further described in §4.6.4.

4.6.1.4 Extended range facilities.

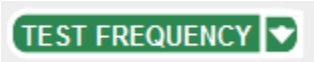


For large area services (FIR and, in some cases also for ACC areas) adequate coverage cannot be provided through a single ground station. In these cases, coverage is extended by using additional ground stations (extended range facilities), all operating on the same nominal frequency, but slightly off-set. Relevant SARPs for these systems are in Annex 10. These stations typically provide for overlapping coverage between each other. Frequency Finder offers the opportunity to identify the *families* of such stations. When such a family of stations is identified in the VHF COM database in the column/field "**Extended Range**", interference between these stations is not considered. Extended Range families need to be introduced in the format ER-xxxx-y where:

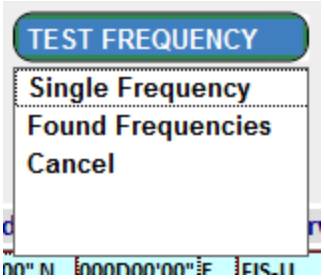
ER is the pre-fix for Extended Range
XXXX is a code to identify a geographical area (Country, FIR)
Y is a number selected by the user (optional).

4.6.1.5 Assessment of potential interference (separation distances)

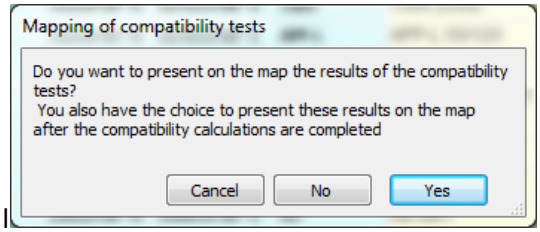
4.6.1.5.1 In Frequency Finder the frequency assignment planning criteria that have been developed by ICAO and are incorporated in the ICAO *Handbook on Radio Frequency Spectrum Requirements for Civil Aviation*, Volume II, *Frequency assignment planning criteria for aeronautical radio communication and navigation systems* (Doc 9718) have been implemented. Appendix H contains the methodology for calculating separation distances and interferences contours that was implemented in Frequency Finder.

4.6.2 Start testing 

4.6.2.1 With the button "**TEST FREQUENCY**" on the VHF COM database window the user is as a first step invited to test *one single* frequency or a *group* of found frequencies (e.g. as a result of a query or selection of frequency assignments):



In case the user selects for the testing of one single frequency, a pop-up menu invites the user to present the results of the compatibility tests on a map with Google Earth. In case the user decides to not present the calculations on a map, only the compatibility calculation results are presented. However, after all calculations have been completed, the user can still decide to present ALL calculation results on the map or only a selection of these (further information is in §4.6.5, §4.6.6. and §4.6.7).



Clicking "Cancel" will cancel the test.

Note: the option to present the results of compatibility tests on a map is not offered in case the user decides to test multiple frequency assignments by clicking in the drop-down menu for the button "TEST FREQUENCY" to option "Found Frequencies". In this case, plotting the results of the compatibility tests on a map has to take place after all compatibility calculations have been completed.

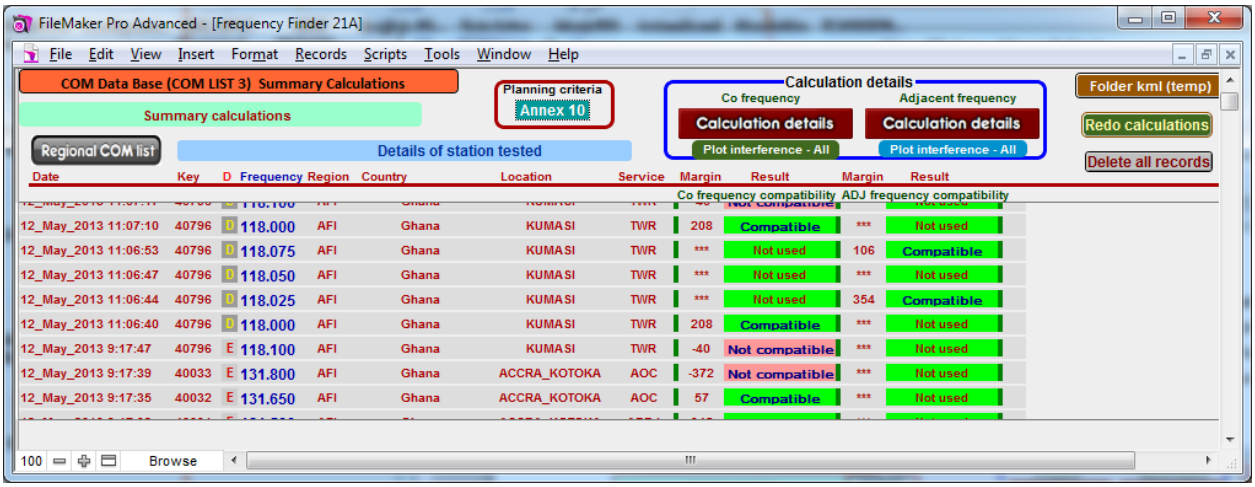
4.6.2.2 After the compatibility calculations (testing) have been completed, the window "Summary calculations" present a summary of the test results (see §4.6.3 and §4.6.5).

4.6.3 Test results

4.6.3.1 Summary calculations

A summary of the test results is presented on the first line (record) in the window **"Summary calculations"**. This window keeps also a record of calculation results of previous compatibility tests that were performed by the user. This window contains some information on the station that has been tested and summarizes the (worst case) calculation results. This window has the following layout:

Window Summary calculations:



For each test, the following information is presented on this window:

Field name:

Date — Date and time stamp of the test

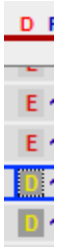
Key — The unique Key # of the frequency assignment that has been tested

D — Identifies whether or not the frequency assignment is for a draft frequency

E = Permanent frequency assignment

D = Draft or temporary frequency assignment.

Note: In case the field D = D, the background color is yellow. This would allow the user, when clicking this (yellow) field to navigate directly to the layout/wind COM Frequency with the view to amend parameters for this frequency assignment.



Frequency — The frequency that has been tested

Region — The Region of the location of the frequency assignment

Country — The country for which the frequency assignment has been made

Location — The location of the frequency assignment that has been tested

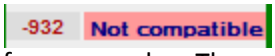
Service — The service of the frequency assignment as is entered in the Global Database

Co-frequency compatibility: Margin and Result of the test

ADJ frequency compatibility: Margin and Result of the test

4.6.3.1.1 The fields **Co-frequency** and **ADJ-frequency** compatibility summarize the co – and adjacent frequency compatibility test results as follows:

In this example the tested frequency is compatible with the frequency plan. The nearest station is 68 NM beyond the minimum separation distance required



In this example the tested frequency is not compatible with the frequency plan. The nearest station is 932 NM below the minimum separation distance required.

In this example the tested frequency is compatible; it not used within the area of 1020 NM around the station that is tested.

TO BE IMPLEMENTED TOGETHER WITH UNPROTECTED ASSIGNMENTS AFTER REVIEW OF COMMENTS FROM REGIONAL OFFICES IN CURRENT VERSION OF FREQUENCY FINDER

In this example the tested frequency is compatible and only used for AOC. In FF all frequency assignments are tested for compatibility between each other, including un-protected frequencies like for AOC although these are, by default, compatible and do therefore not interfere between each other. However, if an unprotected (e.g. AOC) frequency assignment is shared (co- or adjacent channel) with a

protected frequency assignment, any interference between these frequencies is calculated and presented in the summary calculations. AOC frequencies are typically assigned on the basis of frequency or channel loading for a single AOC frequency. In the absence of DOC specifications for AOC frequencies, in Frequency Finder when calculating compatibility the DOC is assumed as operating up to 10000 ft. and a range of 100 NM.

Note: Regions are invited to confirm or modify this assumption.

In this example, the summary shows that the tested frequency assignment is used by extended range facilities. No geographical separation is being calculated for frequencies that operate in an extended range configuration. Extended range facilities that operate in a single extended range network are considered as non-interfering between each other. Interference between stations that operate in an extended range network and those that do not operate in the same extended range network is however marked as interference (non-compatible frequency assignments).

4.6.4 Visualizing test results on the map (co- and adjacent frequency)

4.6.4.2 Examples

4.6.4.2.1 The following screenshots show how the test results, including interference areas relevant data are displayed on the map with Google Earth.

1. No interference (frequency assignments are compatible)

The station that is being tested (area service in Brussels, Belgium, ACC for sectors #656, 989 and 990; Frequency 128.800 MHz is presented together with other co-frequency assignments within a range of 1020 NM from ACC Brussels. In the figure below, the co-frequency assignments which have a positive "interference margin" (the amount (NM) with which the minimum separation distance is exceeded) ~~with a margin of up to + 150 NM~~ are plotted on the map and connected to the frequency under test with a yellow line.
~~The test results for adjacent frequency interference are plotted in with a blue contour and connected with a blue line~~

The following method for presentation of compatible co-frequency assignments has been implemented in Frequency Finder:

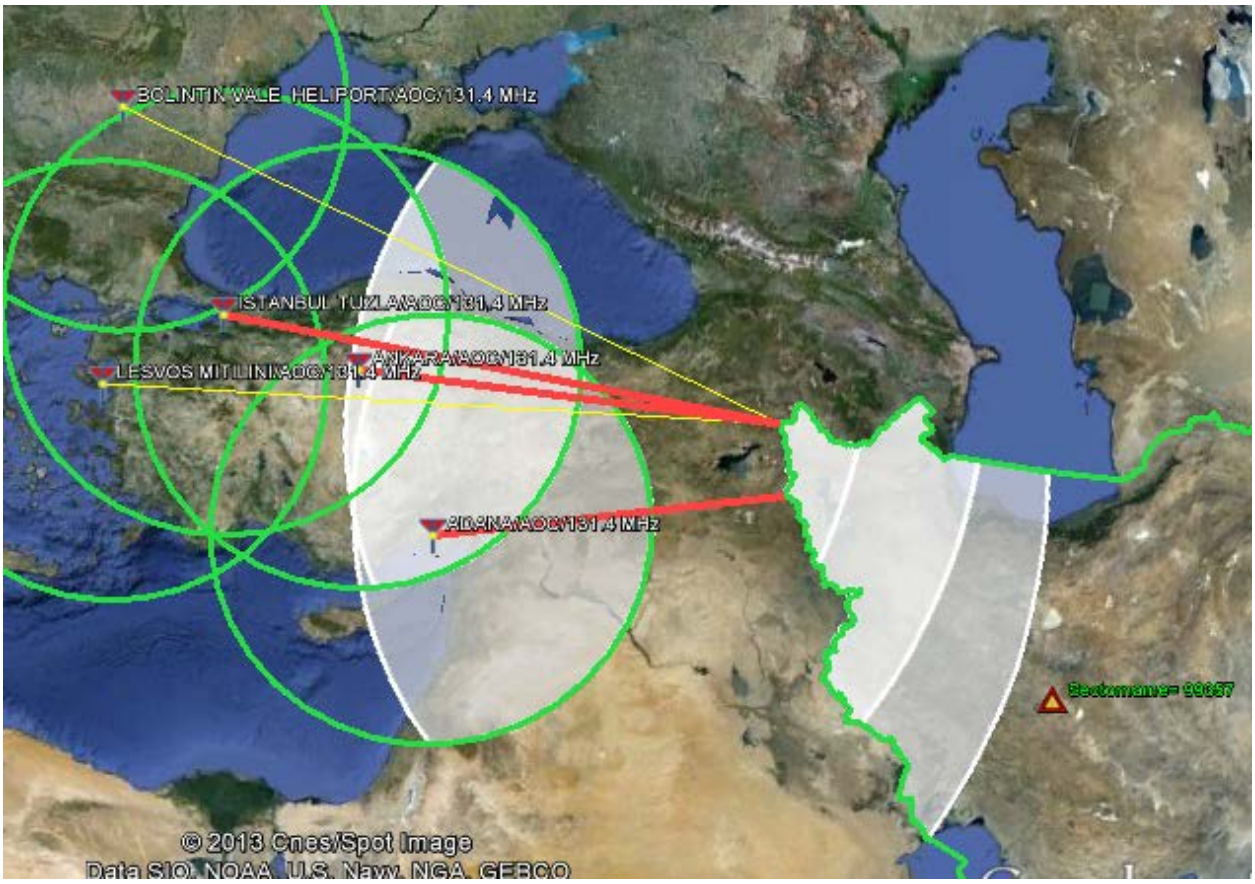
1. The location of the frequency / station being tested (in the example 128.800 MHz at Brussels ACC) is plotted with the icon 

When the frequency assignment is related to an area service (polygon) also the icon  is shown. The contour of the frequency/station being tested is a red line (in case the coverage is circular and in case the coverage is of a polygon.

Other compatible frequency assignments that are plotted on the map are presented with the icon:

.

2. Co-frequency interference (frequency assignments are not compatible)



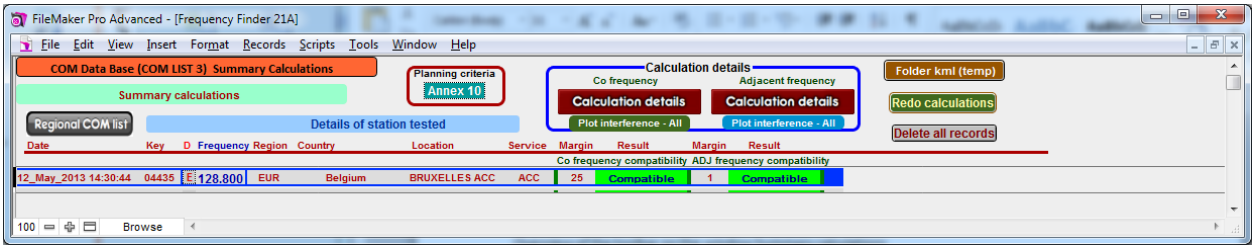
Co-frequency assignments that are incompatible are connected to the frequency being tested (FIR Tehran in the above figure) along the shortest path and connected with a red line. In addition, Frequency Finder calculates the area in which interference may be expected and presents this with a white shaded background on the map. Frequency assignments that are compatible are connected to the frequency being tested with a yellow line.

3. Adjacent frequency (25kHz) interference

Adjacent frequencies are presented with blue contours. In case the frequency assignments are not compatible they are connected with an orange line; when the stations are compatible they are connected with a blue line. In the above example station Leeuwarden (120.700 MHz) is tested against the station Lelystad, which is providing ATIS and operates on the adjacent frequency 120.725 MHz. Interference (air-to-air) is expected in a circle around the coverage of Leeuwarden within the distance of 10 NM of the boundary of the coverage for Leeuwarden. No interference is expected from the station in Lelystad (this is a broadcast station and operates only with ground based transmissions.

4.6.5 Toolbar on the window Summary Calculations.

Overview of the toolbar on the window Summary calculations



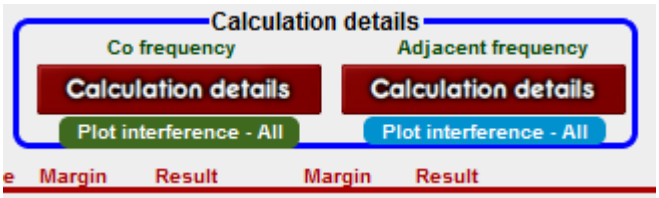
4.6.5.1 

This button returns the program to the VHF COM database window and presents the frequency assign
Returns to the Regional COM list and the frequency that is selected on the table Summary calculations.

4.6.5.2 

With his button the user can select if the compatibility calculations are based on the planning criteria as per Annex 10 or the (legacy) regionally agreed planning criteria.

4.6.5.3



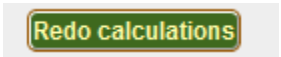
These buttons in the section “Calculation details” navigate to the windows “Co-frequency calculation details” and “Adjacent frequency calculation details” where details of the calculation results are presented, as explained below.

4.6.5.3.1 With the button “Plot interference – all” the calculation results of the most recent calculation are plotted on the map (with Google Earth). The most recent calculation results are those from the uppermost (first) record or frequency assignment on the list. In case the user has selected (activated) another record, a pop-up dialog gives a warning that the calculation results for that frequency assignment cannot be plotted on the map. However, when using the button 

on the toolbar, the user can re-test the active or selected frequency and plot the calculation results on the map after the testing is completed.

4.6.5.4 

This button will delete the summary of calculation results, should these no longer be required. A pop-up dialog box invites the user to confirm (or cancel) the deletion of these calculation results. Deletion of these records does not affect the data contained in the Global data base.

4.6.5.6 

This button re-starts the compatibility calculations of the selected record / frequency assignment and follows the same procedure as described in §4.6.2 when the button **Test Frequency** is clicked. The user will be requested through pop-up menus to plot the calculation results on the map as described in §4.6.2. The compatibility calculations are “re-done” for the active record/frequency assignment.

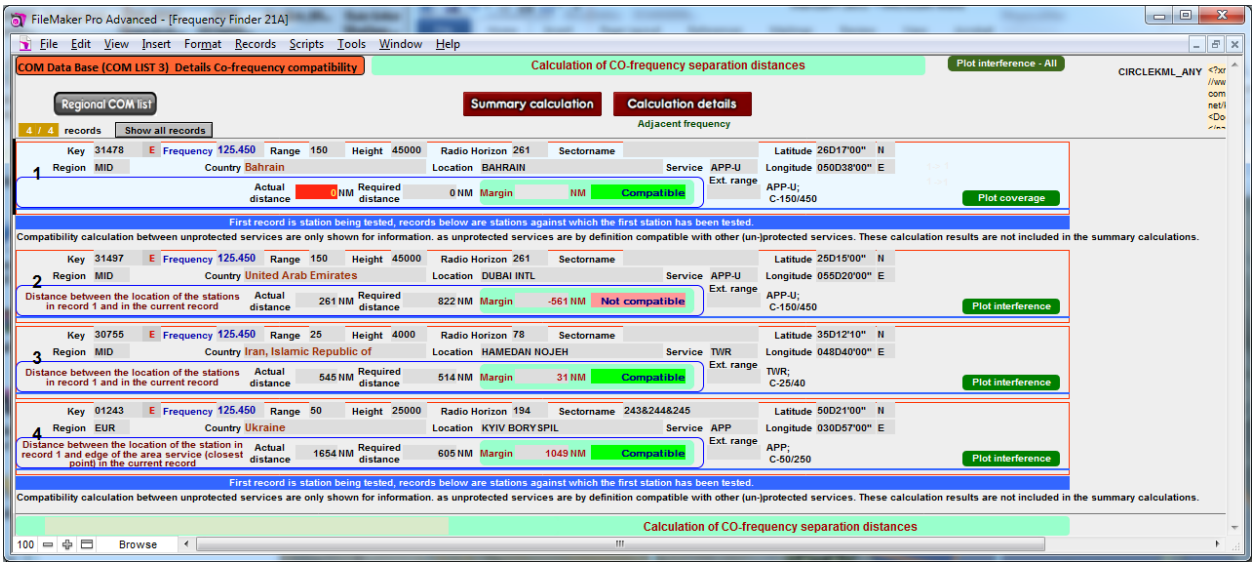
4.6.6. Details co-frequency compatibility.

4.6.6.1 View details of co-frequency compatibility tests

From the window **Summary Calculations** it is possible to navigate to the windows **Co-frequency compatibility** and **Adjacent frequency compatibility** where detailed calculation results are presented. To view the detailed calculation results for the co-frequency compatibility calculations or test results, click the button

4.6.6.2 The window Co-frequency compatibility

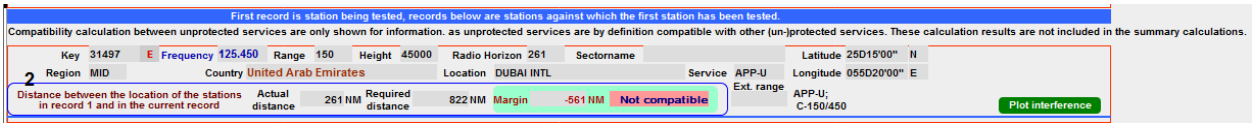
The window Co-frequency compatibility is organized as follows:

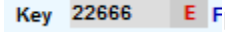


The first frequency assignment on the list (#1) is the record that is being tested on compatibility against the other frequency assignments in the VHF COM database.

The frequency assignments are sorted with the smallest margin at the top of the list. If the margin is negative, the frequency assignment is not compatible with the frequency assignment being tested.

For each frequency assignment the following information is displayed:





Key-number of the frequency assignment; the key number is followed by the letter **D** in case the frequency assignment is draft or temporary and the letter **E** in case the frequency assignment is permanent. In case the letter is D, the background color is yellow. This would allow the

user, when clicking this (yellow) field to navigate directly to the layout/wind COM Frequency with the view to amend parameters for this frequency assignment. (See also §4.6.3.1).

Frequency 118.700 Frequency of the tested station

Region AFI Region for the frequency assignment / station

Country Chad Country where the frequency assignment is registered

Location BRIA Location of the frequency assignment / station

Service ACC-U Service

Latitude 06D32'00" N Latitude of the station

Longitude 021D59'00" E Longitude of the station

Sectorname FIR N'DJAMENA If the station is an area service, the [FIR] sector name or, for the EUR Region, the sector number(s).

Range 260 Designated operational range of the station (for area service the range to the radio horizon at maximum altitude (NM))

Height 45000 Designated operational height for the station (ft)

Radio Horizon 261 Distance to the radio horizon at the maximum designated operational height.

Regional Sep 1000 ~~Minimum required separation distance as per regional frequency assignment planning criteria~~

Actual distance N/A NM Actual distance of the station to the station that is being tested (in row 1)

Required dist. N/A NM Minimum separation distance as per ICAO Annex 10 frequency assignment planning criteria

Separation distances are calculated as follows:

Between circular coverage areas: distance measured between the location of the ground stations.

Between circular coverage and area coverage: distance measured from the location of the ground station of the circular service to the closest point of the contours of the area service

Between area coverage and area coverage: distance measured between the closest points of the respective area services.

See also Appendix H for further clarification. For each frequency that has been tested Frequency Finder identifies from where the distances have been calculated.as follows (examples):

Distance between the location of the stations in record 1 and in the current record or Distance between the location of the station in record 1 and edge of the area service (closest point) in the current record (See also 4.6.5)

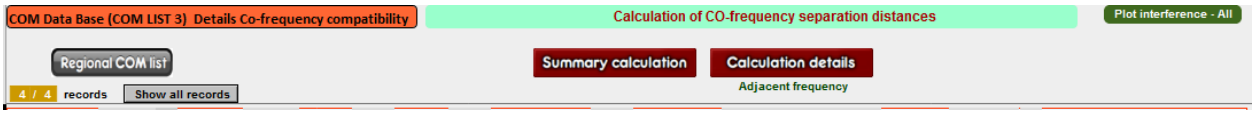
Margin -561 NM Not compatible The margin is the difference between the minimum required separation distance and the actual separation distance. If this number is less than zero, interference is predicted and the box next to the margin reads: Not Compatible with a red background color. When the margin is positive, the frequency assignment is compatible and the box has a green background color.

In case the frequency assignment is part of the same extended range network as the frequency being tested in the first record, this box reads “Extended range”. Also, when the frequency assignment is for AOC and the frequency assignment being tested in the first record is also AOC, the box reads” AOC”. In both cases, the margin is set (forced) to “0”.

This box identifies whether the frequency assignment is part of an extended range network and identifies any such network.

A description of the use of the button “Plot interference” against each frequency assignment on this window is in paragraph 4.6.5.4 below.

4.6.6.3 Toolbar window Co-frequency compatibility.



This toolbar contains the following buttons:

4.6.6.3.1 

This button navigates to the main window for the VHF COM database and shows the Regional COM list of the active record. In case parameters of a recent query are in the table or when a Region has been preset, pop-up menus offer the user options for viewing the Regional COM list. Normally, when returning to the Regional COM list, the relevant record is highlighted.

4.6.5.3.2 

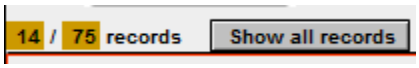
This button navigates to the page with the summary compatibility calculations

4.6.6.3.3 

This button navigates the user to the page with details of the adjacent frequency compatibility calculations.

4.6.6.3.4 

This button allows the user to plot the results of the co-frequency compatibility calculations on the map for all frequency assignments shown.

4.6.6.3.5 

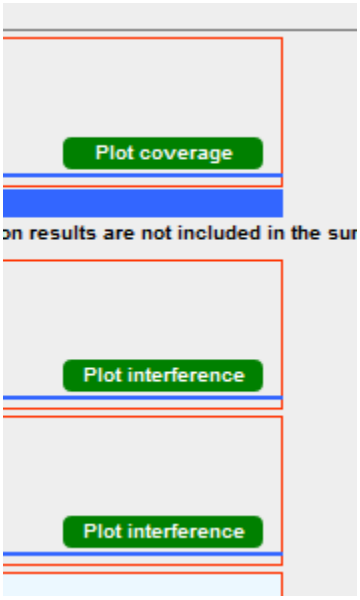
The window co-frequency compatibility only shows the calculation results that are incompatible with the frequency that is being tested (the margin is less than zero) and the calculation results for frequency assignments that are compatible up to a (positive) margin of 150 NM. Other calculation results have been omitted from the list. However, if desired, the user can present the complete table by using the button “Show all records”. In the example in the figure above, 75 frequency assignments (within a range

of 1020 NM from the station being tested) have been found; 12 have a margin less and 150 NM and are presented in the table.

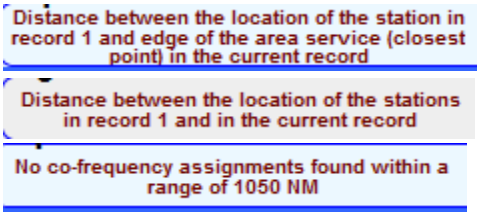
4.6.6.4 Plot single interference case.

For each frequency assignment on the window summary calculations a button “Plot interference” has been placed. This button permits the user to plot a single interference case on the map. This facilitates the analysis of interference cases when using the map.

In case no interference has been calculated (and for the first frequency assignment on the list) the button plots only the designated coverage on the map.



4.6.6.5 Text messages contain clarification and information on the calculated separation distances:



These messages have been inserted to provide some background information to the user on the results of the compatibility testing.

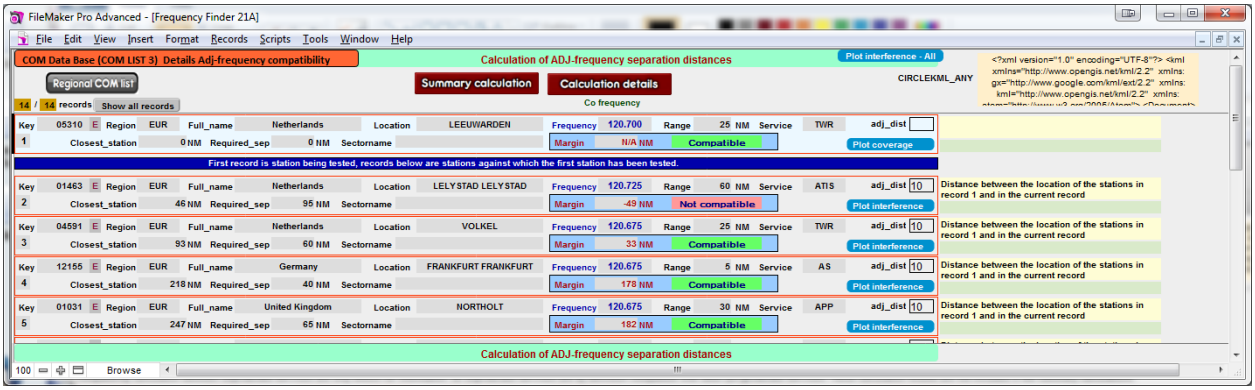
4.6.7 Details adjacent frequency compatibility

4.6.7.1 View details of adjacent frequency compatibility tests

The user can view the detailed calculation results for adjacent frequency compatibility by clicking on the page **Summary calculations** or on the page **Co-frequency** compatibility the button 

4.6.7.2 The window Adj-frequency compatibility

Details for adjacent frequency compatibility tests are presented in the window **Adj. frequency compatibility** as follows:



The first frequency assignment on the list is for the station that is being tested; the other frequency assignments are those considered in the testing.

For each frequency assignment the following information is provided:

Key 05305 Key-number of the frequency assignment. The key number is followed by the letter D in case the frequency assignment is draft or temporary and the letter E if the frequency assignment is permanent.

Region EUR Region for the frequency assignment / station

Full_name Netherlands Country where the frequency assignment is registered

Location GRONINGEN EELDE Location of the frequency assignment / station

Frequency 118.700 Frequency of the tested station (on the first row) or the adjacent frequency (plus or minus 25 kHz) of the other stations in this list

Range 25 NM Designated operational range of the station (for area service the range to the radio horizon at maximum altitude (NM))

Service TWR Type of service

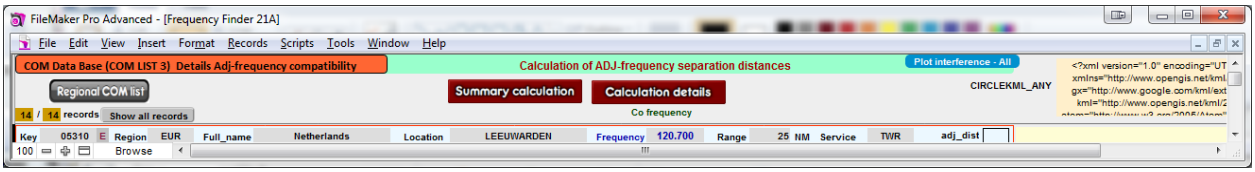
Closest_station 52 NM Actual distance of the station to the station that is being tested (in row 1)

Required_sep 60 NM Required separation distance between the stations involved

Sectorname If the station is an area service, the [FIR] sector name (for the EUR Region the sector number)

Margin -8 NM Not compatible The margin is the difference between the required separation distance and the actual separation distance. If this number is less than zero, interference is predicted and the box next to the margin reads: Not Compatible.

4.6.7.3 Toolbar window Adjacent frequency compatibility.



The toolbar for the window Adjacent frequency compatibility contains the following buttons:

4.6.7.3.1 

This button navigates to the main window for the Global Database and shows the Regional COM list.

4.6.7.3.3 

This button navigates to the page with the summary compatibility calculations

4.6.7.3.4 

This button navigates the user to the page with details of the adjacent frequency compatibility calculations.

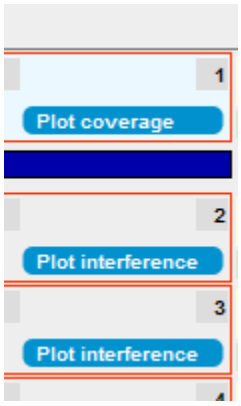
4.6.7.3.5 

This button allows the user to plot the results of all co-frequency compatibility calculations on the map. To plot a single interference case, see paragraph 4.6.6.4 below.

4.6.7.3.7 

For a description of this button, see paragraph 4.6.6.3.5 above

4.6.7.4 Plot single interference case.



For each frequency assignment that has been tested the button “Plot interference” has been placed. This button permits the user to plot a single interference case on the map. This facilitates the analysis of interference cases when using the map. In case no interference has been calculated (and for the first frequency assignment on the list) the button plots only the designated coverage on the map. The numbered field indicates the order of the records in the table.

4.6.7.5 Text messages, similar to those described in §4.6.6.5 provide clarification on the information that is presented in this window:

Distance between the location of the stations in record 1 and in the current record
Distance between the location of the stations in record 1 and in the current record

4.7 Introduction of a new or a modified frequency assignment

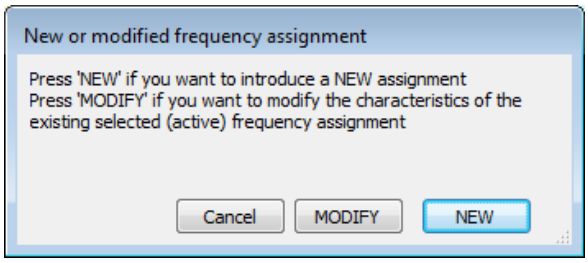
4.7.1 Initializing a new or modified frequency assignment.

4.7.1.1 A new frequency assignment can be added to the VHF COM database and the characteristics of an existing frequency assignment can be modified in FF.

4.7.1.2 On the window **VHF COM Database** the button, 

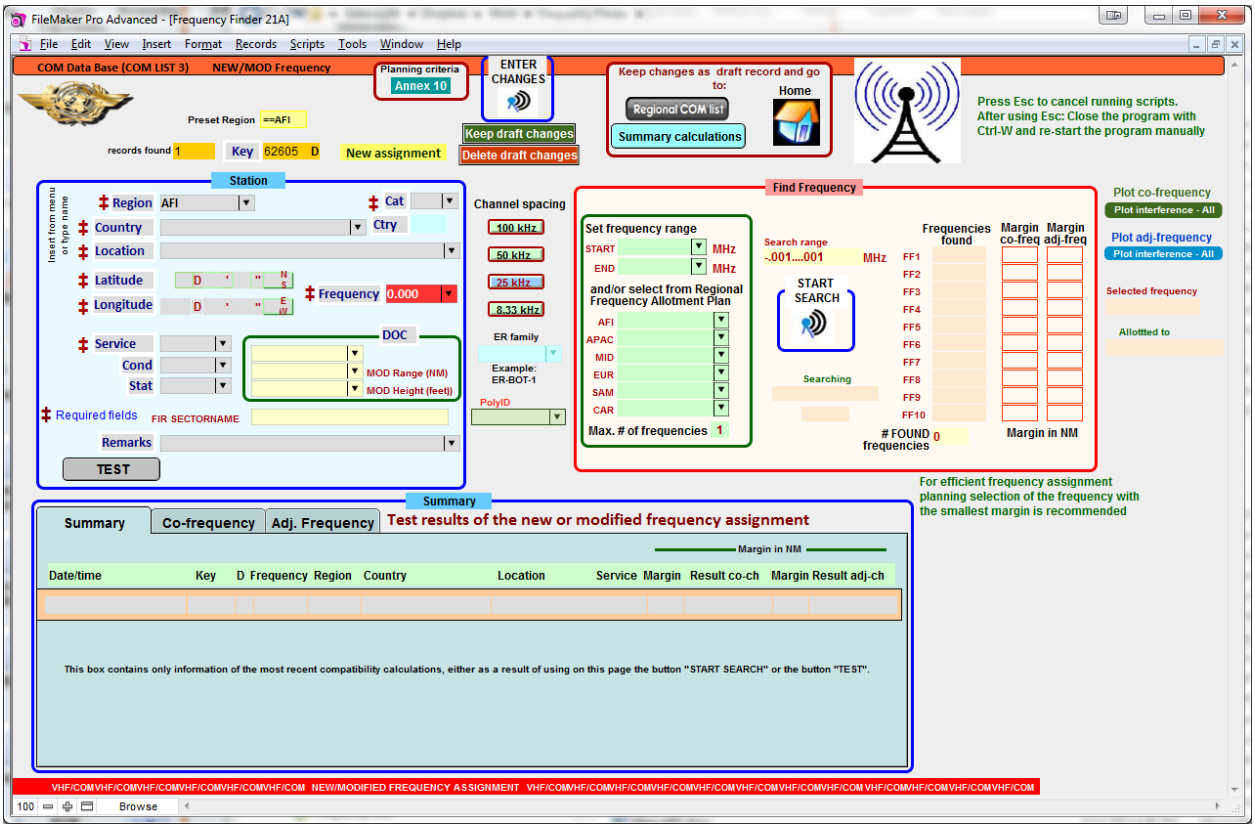
takes the user to the window **NEW/MOD Frequency** where the modifications to the VHF COM database can be inserted.

4.7.1.3 When clicking the button, the user is invited with a pop-up dialog box to clarify if a new frequency assignment should be added to the VHF COM database or if the characteristics of the existing frequency assignment are to be modified:



Note: In case the active frequency is a draft or temporary frequency assignment, Frequency Finder skips the pop-up menu.

4.7.1.4 Click **NEW** to open the window **NEW/MOD Frequency** as follows:



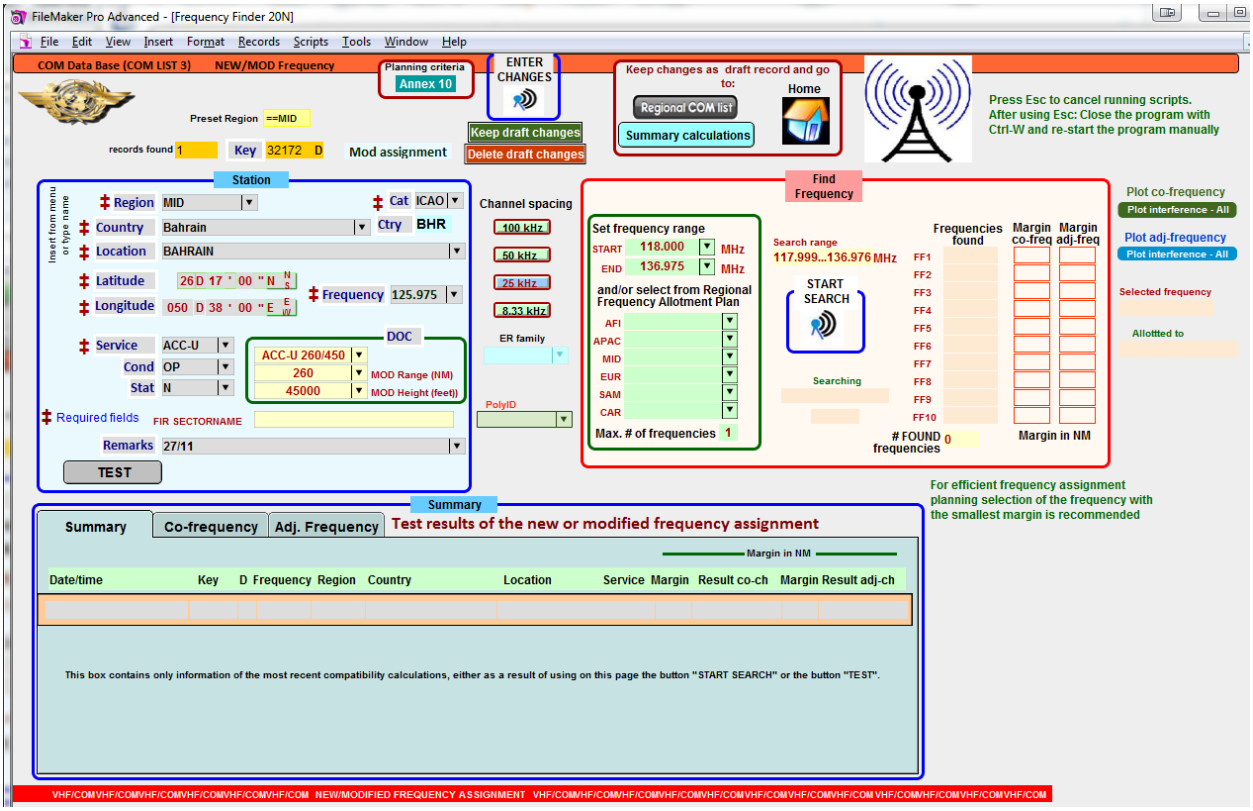
In this window the (blue) box “Station” only the box “Region” is filled and contains the name of the Region to which Frequency Finder has been “preset” (see § 3.4.6) or, when no Region has been “preset”, the name of the Region of the active record prior to clicking the button NEW/MOW Frequency. All other fields in this box are empty and the user is requested to insert the characteristics specific to the station.

For a new frequency assignment, a new a new record is generated in the database with a unique Key number and, until the new frequency assignment is added permanently to the Global Database, this frequency assignment is marked with **D.** This draft record is subject to testing and/or coordination.

The user needs to fill out all the essential fields (marked with ‡) and can test the new record (frequency assignment) and/or keep it as a draft or as a permanent frequency assignment with the buttons “ENTER CHANGES” or “Keep draft changes” on the toolbar. In case the user attempts to enter the new record permanently to the database with the button “ENTER CHANGES” or as a draft/temporary record with the button “Keep draft changes” without having filled out the required data in the “Essential fields”, a pop-up menu will warn the user to fill out these fields before continuing.

Further instructions on how to introduce, test, search for new or replacement frequencies are in §4.7.3 and further below.

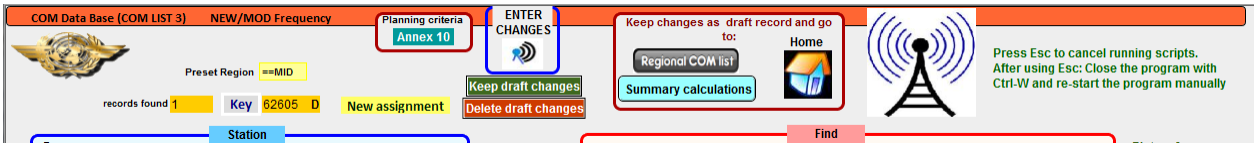
4.7.1.5 Click **MODIFY** on the pop-up menu in paragraph 4.7.1.3 to open the window **NEW/MOD frequency** as follows:



Essentially, the same window as described in 4.7.1.4 opens and with the same functionality. The only difference between the two windows is that, in case of *modifying* a frequency assignment, the characteristics of the frequency assignment to be modified have already been added to this window. The procedure for introducing characteristic and finding a frequency for a new frequency assignment is the same as for modifying a frequency assignment.

For a modified frequency assignment, a new [draft] entry is added to the VHF COM database (which is a copy of the original frequency assignment) with the same Key number as the original frequency assignment and with "**D"** added (instead of the **"E"** which is used for permanent frequency assignments).

4.7.2 New/Mod frequency window Toolbar

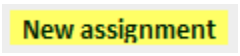


4.7.2.1 The toolbar of this window provides for the following functions and information:

This field identifies when a Region has been preset (see §3.4.6). If no Region has been preset, this field is empty.

On this window the number of records found should always be 1.

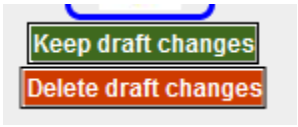
This field contains the Key for the frequency assignment. On this window the Key should always be followed by the letter D which notifies that a draft modification is being considered.
Note: Frequency assignments can only be added or modified through this window.

This field identifies that modifications to an existing frequency assignment are being considered. This field reads 

when a new frequency assignment is being added to the VHF COM database

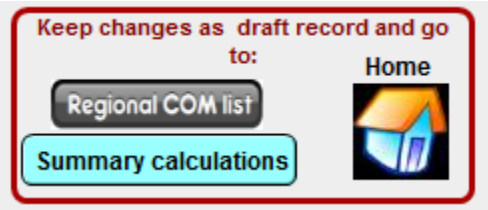
Sets the frequency assignment planning criteria used in the calculations for the compatibility of the draft frequency assignment to either the Annex 10 or the regionally agreed criteria (see§ 4.6.1.1)

This button enters into the VHF COM database the characteristics for the new or the modified frequency assignment *PERMANENTLY*.
Note: old deleted or modified records/assignments are kept for future references in a separate table that can be accessed from the window VHF COM Database; COM List 3



The button **Keep draft changes** returns to the COM list (VHF COM Database) and keeps the draft changes (or the draft new frequency assignment) in the database. This will allow for completion of the coordination of a new (or modified) frequency assignment while during the coordination period the draft frequency assignment is protected.

The button **Delete draft changes** returns to the COM list and deletes the draft frequency assignment from the database. (E.g. in case the proposed modification is canceled by the State or the Regional Office).
Note: A draft frequency assignment can also be deleted from the window VHF COM database.



The three buttons in this field allow the user to navigate to the windows:
Regional COM List (main data base)
Summary calculations
Home page

When these buttons are used, the draft frequency assignment will ***remain*** in the VHF COM database and marked as a draft frequency assignment with the letter D added to the Key. This allows for the draft frequency assignment to be considered in further compatibility testing. All draft frequency assignments in the Global Database can be queried with the button on D the window **VHF COM database** (see also §4.3.1).

4.7.3 New frequency or modifying existing frequency.

Note: the following equally applies to the introduction of a new frequency assignment and the modification of the characteristics of an existing frequency assignment.

The window **NEW/MOD** frequency has the following three panes:

(i) Station — Station
(ii) Find Frequency — Find Frequency
(iii) Summary — Summary

4.7.3.1 Station characteristics Station

When on the pop-up menu "New or modified frequency assignment" (see §4.7.1.4) the button **NEW** has been selected, the fields in the pane **Station** are empty. From drop-down menus or by typing, the characteristics pertinent to the new frequency assignment can be entered.

The following data (marked ‡) ***needs*** to be inserted since this is information relevant to maintain the Global Database and for compatibility calculations:

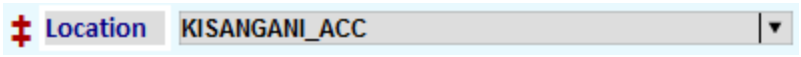
Note: to avoid misspelling of data relevant to the frequency assignment which may impede the functions of the program, it is highly recommended to use, as much as possible, the drop-down menus in these fields to insert data in the fields of this pane.

‡ Region AFI — Select the appropriate Region from the drop-down menu

‡ Cat ICAO — Select whether the frequency assignment satisfies an ICAO or a national requirement

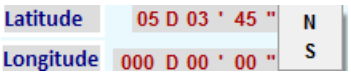
‡ Country Democratic Republic of the Congo — Select the relevant country name from the drop-down menu.

The ICAO abbreviation for that country will be entered automatically in the field 



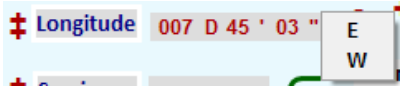
Select the location from the drop-down menu for an already existing location in the data base or type the name for a new location.

Enter the latitude of the location of the station. The latitude needs to be entered in the format DDMMSS. Leading zeros must be added by the user; the program jumps automatically to the next field. Alternatively, the user can jump to the next field with the Tab button on the keyboard in which case leading zeros will be added automatically. E.g. when manually entering 050345, the data of the coordinates is entered into the relevant DD, MM or SS field as follows:

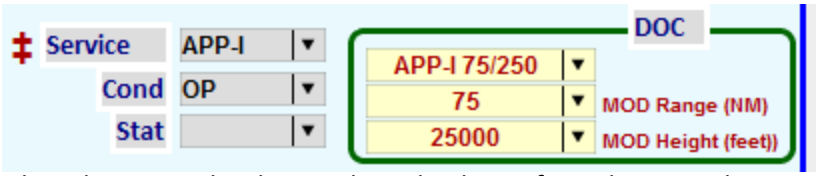


When the seconds for the coordinates are entered, a drop-down menu offers the choice to enter N (North) or S (South)

Enter the longitude of the location of the station. The longitude needs to be entered in the format DDDMMSS. Leading zeros must be added by the user; the program jumps automatically to the next field. Alternatively, the user can jump to the next field with the Tab button on the keyboard in which case the leading zeros will be added automatically. E.g. when manually entering 0074503, the data of the coordinates is entered into the relevant DDD, MM or SS field as follows:



When the seconds for the coordinates are entered, a drop-down menu offers the choice to enter E (East) or W (West)



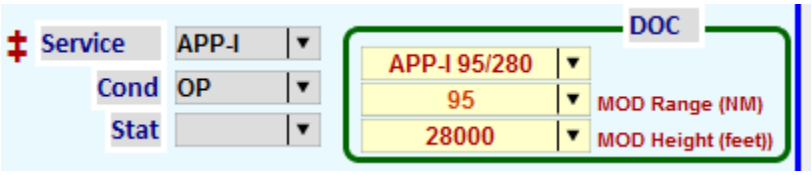
Select the service for the frequency assignment from a drop-down menu.

When the service has been selected, the uniform designated operational coverage as per Table B-1 (Appendix B) is automatically entered in the box **DOC**.

4.7.3.1.1 In the above example, after having selected from the drop-down menu of the field **Service** the service APP-I, the uniform DOC for the APP-I service (75 NM/25000 ft) has been automatically be inserted.

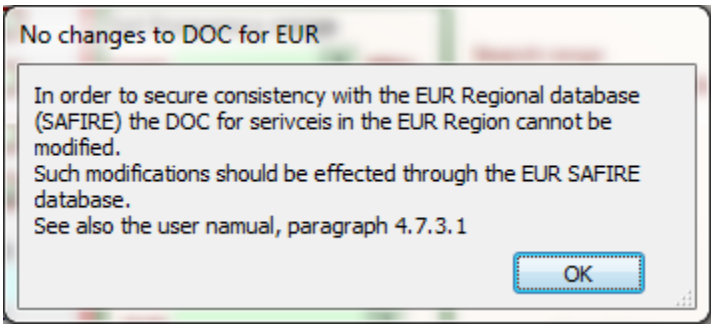
4.7.3.1.2 The user can either continue with this standard DOC or introduce a custom DOC for this service. The custom *DOC Range* can be entered in the box MOD Range (NM), either by using a drop down menu or by typing a range (in NM) in the field. The *DOC Height* can be entered in the box MOD Height, either by using the drop-down menu or by typing a height (in feet) in the field.

Example: In case the DOC for theAPP-I should be changed into 95/280, the values in the field (DOC) APP-I 75/250 can be modified (by typing) in the box MOD Range a new range (e.g. 95 NM) and in the boc MOD Height a new height of 28000 ft. The box DOC now read APP-I 95/280 and the new DOC (95/280) will be used in new compatibility calculations.



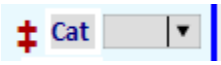
Note: Non-uniform values for Range and Height can be inserted from a drop-down menu or typed in the fields MOD Range and/or MOD Height..

Note: In Europe a different method for identifying DOC is being used; although this method has been accommodated for compatibility calculations in **FF** *and to secure consistency with the European database (SAFIRE) this method has [currently] not been implemented in* **FREQUENCY FINDER** *for new frequency assignments or for modified frequency assignments. A pop-up menu gives the following warning:*



Note: When the uniform values for the designated operational coverage are to be used, the fields in the box ***DOC*** *should not be modified and the DOC that is being entered when selecting a Service should be maintained.*

Note: The current method of identifying DOC in Frequency Finder is to be expanded with identifying a DOC for frequency assignments in the EUR Region.

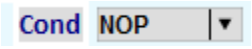


From the drop-down menu, either ICAO (for frequency assignments that are in the ICAO Regional Plan) or NAT (for other (national) frequency assignment) should be selected.

In the field **Frequency**, a frequency can be selected by the user for the new frequency assignment from the drop down menu.

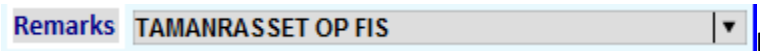
In case the box “Channel spacing” 25 kHz has been clicked (button is blue), the drop-down menu only shows 25 kHz frequency assignments.
When the box 8.33 kHz is clicked, the drop-down menu only shows 8.33 kHz channels

Additional information (not essential) pertaining to the frequency assignment MAY be added in the following fields, as necessary:

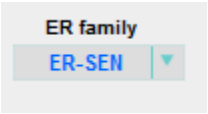


Information concerning the condition of the frequency assignment (operational or not operational)

Information on the status of the frequency assignment



Remarks which are relevant to the frequency assignment (e.g. planned by 2021 or Surveillance Radar).



In this field the user can add the name of any extended range network of which the station is a member (e.g. ER-SEN as a name for the extended range network for FIR DAKAR). Frequencies that are part of the same extended range network are not tested between each other. These systems (normally) work with the ICAO off-set carrier system (Re. Annex 10, Volume III, Part II).

Note: The user is free to name the ER network. It must be preceded however with the prefix “ER-“. For existing ER network names the user can review the list of ER names with the drop-down list.

Note: See also §4.1.6.4

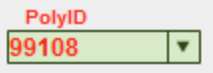
Note: the current ICAO COM lists need to be updated with this information to avoid unnecessary reports of incompatibilities.

4.7.3.2 Sector name

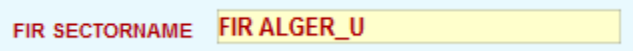
Frequency assignments can be related to an area service like FIS or ACC. In Europe extensive use is made of the provision to provide protection throughout a specified area (polygon) for a variety of uses. This method of frequency assignment planning improves efficient use of frequency assignments.

For frequency assignments in Europe, the table of polygons that describe the area services has been imported in Frequency Finder from the SAFIRE database. For potential application (on a global basis) the polygons all FIR sectors have been imported from the ICAO program ICAOFIR. The table that maps the polygon names for FIR sectors with numbers used in Frequency Finder is in Appendix G. No such table has been prepared for the EUR polygons as these are managed outside the scope of Frequency Finder and imported in Frequency Finder von a regular basis.

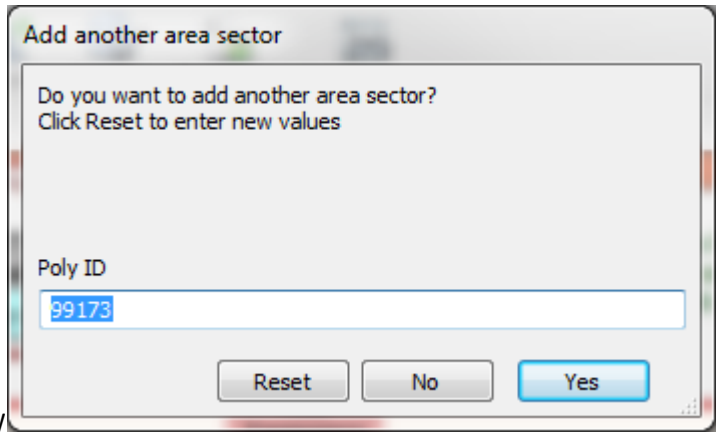
To link a frequency assignment to a particular FIR sector, take the number for the FIR sector from the list in Appendix G.
Enter this number (either by typing or from the drop-down menu) in the field **PolyID**



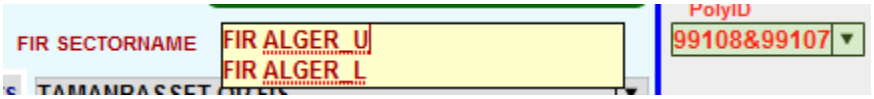
The field FIR SECTORNAME in the box “Station” shows the FIR sectorname:



Example: PolyID 99103 has been assigned to FIR ALGER-UL. When selecting from the drop-down list of the field PolyID the number 99108, the FIR Sectorname FIR ALGER-U will show in the field *FIR SECTORNAME*. At the same time a custom dialog box invites the user to add another sector (e.g. FIR DAKAR-U). The user can add up to 10 sectors. When the selection is complete, the user clicks “No” and the numbers of the selected sectors are in the field PolyID.

W 

In the example below, FIRALGER_U and FIR ALGER_L have been linked to the frequency that is being added or modified.

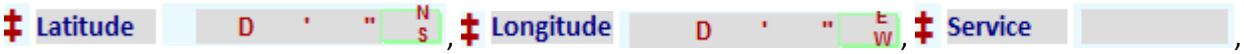


Frequency Finder now assesses the compatibility of the frequency for FIR Alger throughout the coverage of FIR Alger L AND FIR Alger U.

FREQUENCY FINDER automatically enters in the columns **Ch-date** and **Ch-by** on the window **VHF COM database** the computer name and the modification date in the VHF COM database (see §4.2.2).

4.7.4 Testing of the new (or modified) frequency assignment.

4.7.4.1 When data is entered in one or more of the following fields:

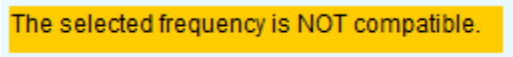


the button 

turns red into 

. This is to alert users to test the modifications to the draft frequency assignment to test compatibility with other frequency assignments in the VHF COM database. After having completed the testing, the button turns back to gray.

4.7.4.2 When the test results indicate that the new frequency assignment is not compatible with other frequencies in the VHF COM database, a box next to the button TEST pops-up as follows:



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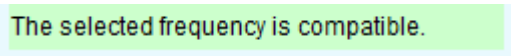
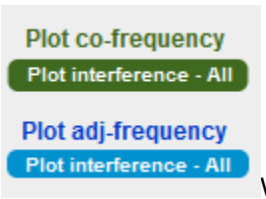
4.7.4.3 When the test results indicate that the new frequency assignment is compatible with other frequencies in the VHF COM database, a box next to the button TEST pops-op as follows:



*Note: testing of the new frequency assignments can be performed any time by clicking the button **TEST**. In case the user navigates away from the window **NEW/MOD Frequency** without testing the modifications to the frequency assignment, a pop-up menu alerts the user to this and invites to undertake such testing.*

4.7.4.4 Plot the results of co-frequency and/or adjacent-frequency interference calculations



With the button Plot co-frequency interference or plot adjacent interference the calculation results obtained with the button “TEST” in the pane “Station” can be plotted on a map with Google Earth. The calculation results are also available on the window “Summary calculations” and detailed calculation results on the relevant window “Details Co-frequency compatibility” and “Details adjacent frequency compatibility. The presentation of the calculation results on the various windows in Frequency Finder and on the map (with Google Earth) is the same as described in section 4.6

4.7.5 Test results of the new or modified frequency assignment.

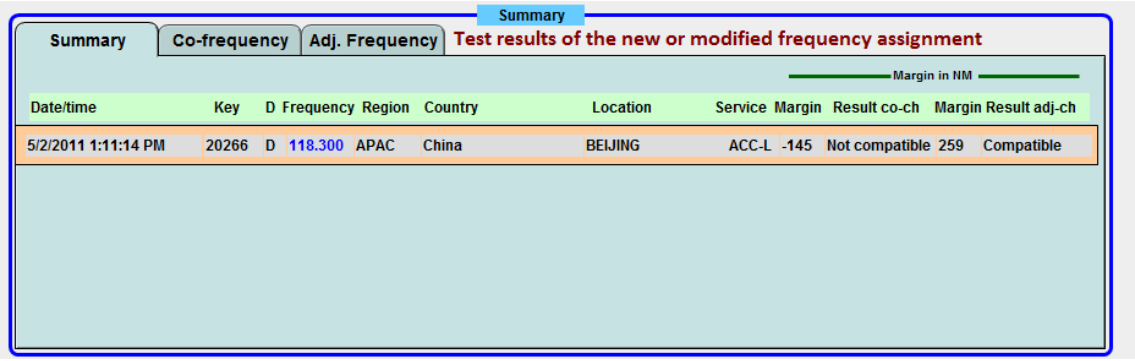
4.7.5.1 The pane Summary contains a summary of the test results.

Three tabs are available in the pane **Summary** to review the test results:

1. the **Summary** tab
2. the **Co-frequency** tab
3. the **Adjacent frequency** tab.

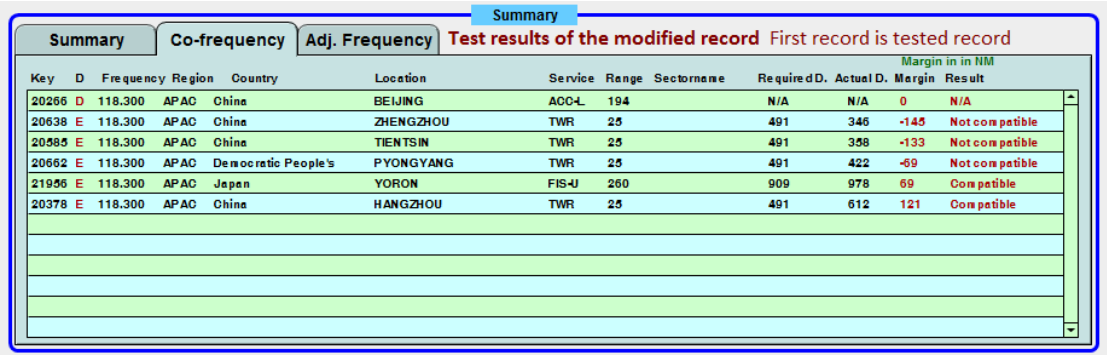
The view of these tabs is as follows:

4.7.5.1.1 Summary tab:



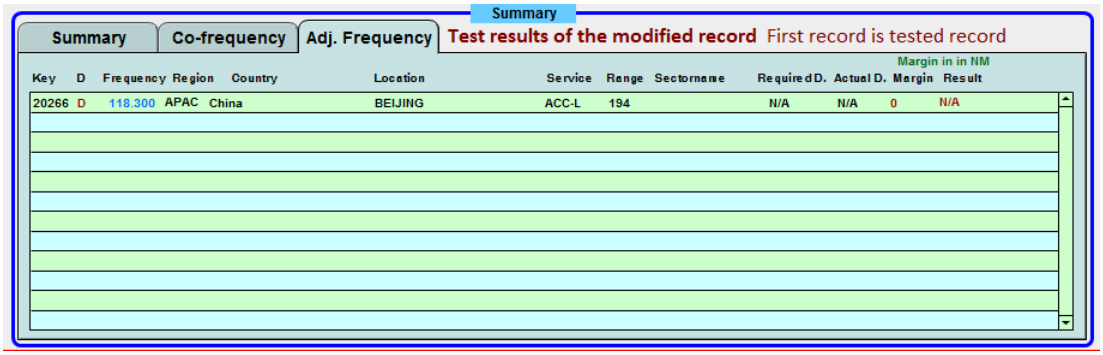
This tab shows a summary of the calculation results. More details of the summary can be found at the page **Summary Calculations**. (Click button Summary calculations on the toolbar (see also §4.6.2.1 for a description of the summary calculations).

4.7.5.1.2 Co-frequency tab:



This tab shows some details of the co-frequency test results, including a list of the frequency assignments that have been considered in these tests. More details of the test results can be found on the window **Detailed Co-frequency compatibility**. Click the button **Summary Calculations** on the toolbar and the button **Co-frequency calculation details** on the page **Summary Calculations** to view the detailed test results.

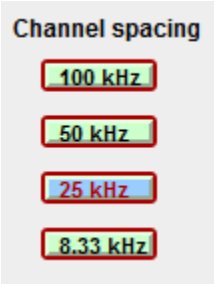
4.7.5.1.3 Adj. frequency tab:



This tab shows some details of the adjacent frequency test results, including a list of the frequency assignments that have been considered in these calculations. More details of the test results can be found at the window **Detailed Adj-frequency compatibility**. Click the button **Summary Calculations** on the toolbar and the button **Adjacent frequency calculation details** on the page **Summary Calculations** to view the detailed test results.

4.7.6. Buttons channel spacing.

4.7.6.1 On the window NEW/MOD frequency the channel spacing to be used in the calculations can be set with the buttons **Channel spacing**:



4.7.6.2 When the button 25 kHz, 50 kHz or 100 kHz is clicked (blue) frequency compatibility is calculated with the characteristics that apply to radio equipment designed for **25 kHz channel spacing**. In some cases however, selection of a frequency on 50 kHz or 100 kHz increments may be desired and in this case the frequency separation (channel spacing) can be set to 50 kHz or 100 kHz. This will effectively reduce the drop-down menu in the field **Frequency** in the pane **Station** to show only frequencies with 50 kHz or 100 kHz increments. ***Frequency compatibility testing however is based on 25 kHz channel spacing characteristics in these cases.***

Note: When searching for new frequency assignments clicking the button 25 kHz searches (finds) frequency assignments in accordance with the planning criteria for 25 kHz channel spacing and with 25 kHz intervals. When the button 50 kHz or 100 kHz is clicked, Frequency Finder searches (and finds, If available) frequency assignments on either 50 kHz or 100 kHz intervals but with frequency assignment planning parameters for 25 kHz channel spacing (in accordance with the Regional frequency assignment planning parameters)

See also §4.7.7 below.

4.7.6.3 When the Channel spacing button 8.33 kHz is clicked (blue), compatibility is ALWAYS calculated with the characteristics that apply to radio equipment designed for **8.33 kHz channel spacing**. The drop-down menu in the field "**Frequency**" in the pane **Station** shows now only channel numbers that apply to 8.33 kHz channel spacing**. Frequency compatibility testing is based on 8.33 kHz channel spacing characteristics**.

4.7.6.4 Compatibility calculations for frequency assignment on 25 kHz channels or on 8.33 kHz channels do take into account the planning criteria either for co-frequency or adjacent frequency adjacent frequency assignment planning for 8.33 kHz and 25 kHz channel spacing in a mixed environment.

For example, the frequency/channel 119.000 MHz (25 kHz channel) is to be considered as co-frequency with the 8.33 kHz channels:

Channel	Frequency (MHz)	Channel spacing
118.990	118.9917	8.33 kHz
119.000	119.0000	25 kHz
119.005	119.0000	8.33 KHz
119.010	119.0083	8.33 kHz

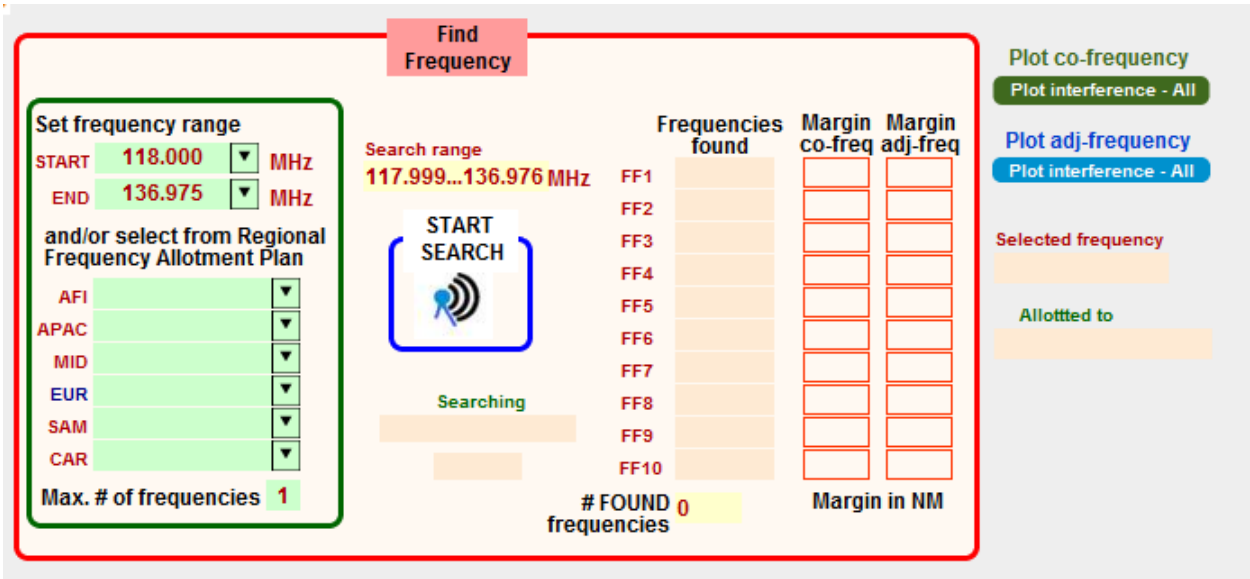
Note: For more information on the channel spacing and relevant separation distances between stations operating on the same or adjacent frequencies see Doc. 9718, Handbook on radio frequency spectrum requirements, Volume II.

4.7.7 Search for new frequency

4.7.7.1 Find Frequency

The pane **Find Frequency** provides for the functionality to search for frequencies that can be assigned to the station of which the characteristics have been entered or modified in the pane **Station**.

Note: The procedure is the same for finding a frequency (frequencies) for a new frequency assignment as for finding an alternative frequency (frequencies) for an existing frequency assignment.



When searching for a compatible frequency assignment, the following steps should be considered or taken.

4.7.7.1.1 Select channel spacing (See also §4.7.6)

Select the channel spacing. Default is 25 kHz channel spacing and, in most cases, 25 kHz channel spacing should be used which will result in finding frequencies with 25 kHz increments.

Note: This may be deleted if considered not useful

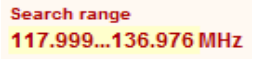
When a new frequency assignment is to be found with 8.33 kHz channel spacing characteristics, the **Channel spacing** button ***8.33 kHz*** should be clicked.

4.7.7.1.2 Select the frequency range

Select the frequency range within which of FREQUENCY FINDER should search for compatible frequencies. For the selection of the frequency range, two options are available:

4.7.7.1.2.a Set the frequency range by entering a start and end of the range in the boxes

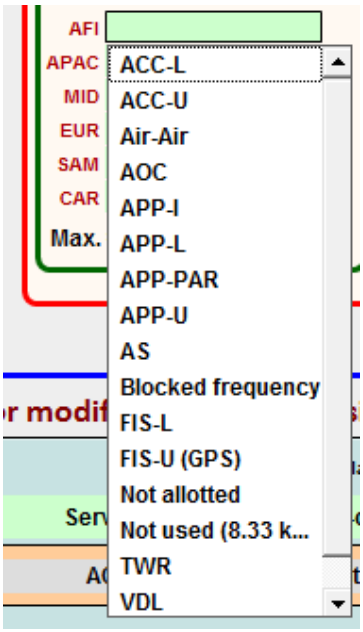
This can be done by selecting the desired start and end frequency with the drop-down menu of these fields. When a range has been set, the selected range is shown in the field



Note: The frequency range that can be selected is based on intervals of 25 kHz. If considered necessary, intervals of 8.33 kHz could be introduced when frequency assignments on 8.33 kHz channels are to be made.

4.7.7.1.2.b Alternatively, from the fields AFI, APAC, MID, EUR, SAM, CAR the frequencies that have been allotted to a particular service in the Regional Frequency Allotment Plan can be selected for a new frequency assignment. These allotment plans are summarized in Appendix D. The relevant allotment can be selected from a drop-down menu from the relevant Region. The selection of the allotment from the drop-down menu should, as closely as possible, match the selection of the Service in the pane **Station**. In case no suitable frequency can be found in a particular allotment, other allotments can be considered for searching for a frequency assignment.

An example of the drop-down-menu containing the allotments for the AFI Region is:



Note: details on the Regional allotment plans are in Appendix D to this Manual or in the ICAO Handbook on Radio Frequency Spoectrum Requirements for Civil Aviation, Volume II, Supplement and can be downloaded from the ACP Web-site at
http://legacy.icao.int/anb/panels/acp/repository%5CHandbook%20Vol%20II_Supplement_8May2013.zip
and the relevant Regional Air Navigation Plans

4.7.7.1.3 Select the maximum number of available frequencies from the drop-down menu of the field Max. # of frequencies 1 . The number can be selected from 1 – 10.

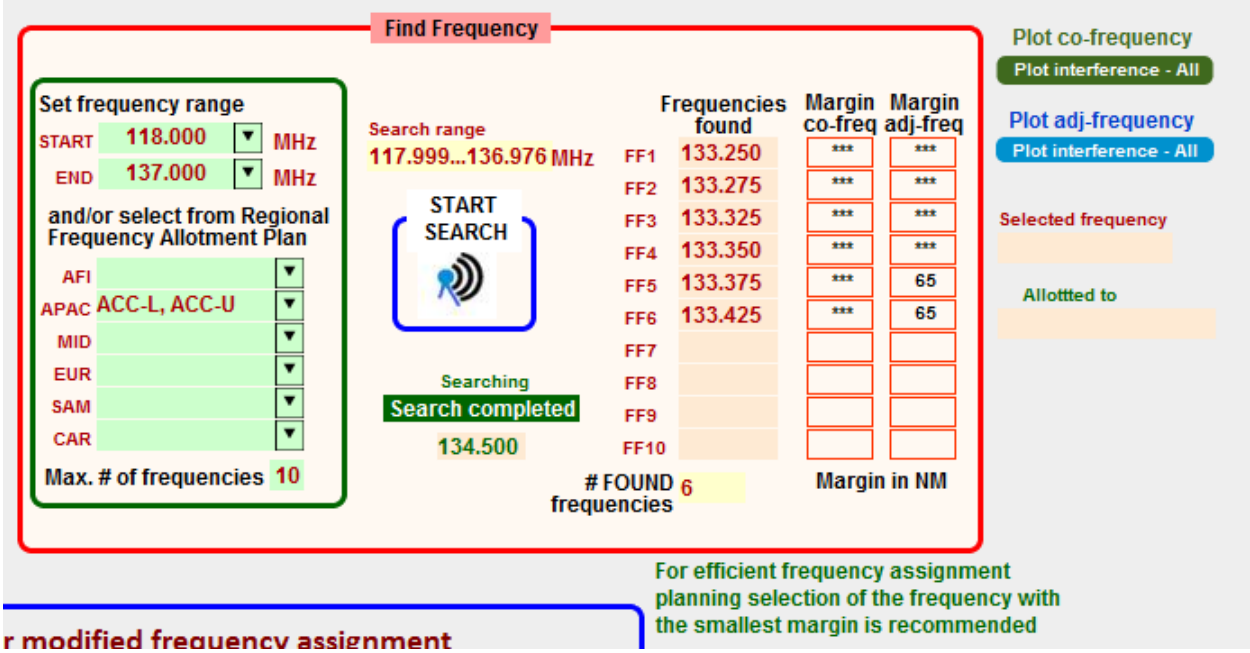
4.7.7.1.4 Click 

to start FREQUENCY FINDER to search for a new frequency assignment.

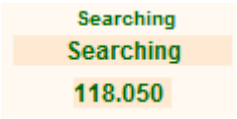
4.7.7.2 Start Search

After having clicked the button **START SEARCH**, FREQUENCY FINDER starts to test if the new frequency within the range that has been selected is compatible with other frequency assignments in the VHF COM database. The search starts from the lowest frequency in the selected frequency range (or the lowest frequency in the allotment). When of FREQUENCY FINDER finds a compatible frequency this frequency is listed in the column **Frequencies found**. After the search for frequency assignments is completed, the following information is shown in the pane **Find Frequency**:

Note: in the example below, Frequency Finder was requested to search for 10 frequencies (25 kHz channel spacing) in the APAC Region that are allotted to ACC-L and ACC-U services (China, Hong Kong, CHEP LAP KOK). Within the allotment for ACC-U in the APAC Region, Frequency Finder could only find 6 frequencies for this location.



4.7.7.2.1 During searching, the field **Searching** is set to "Searching" and the actual frequency that is being tested is shown:



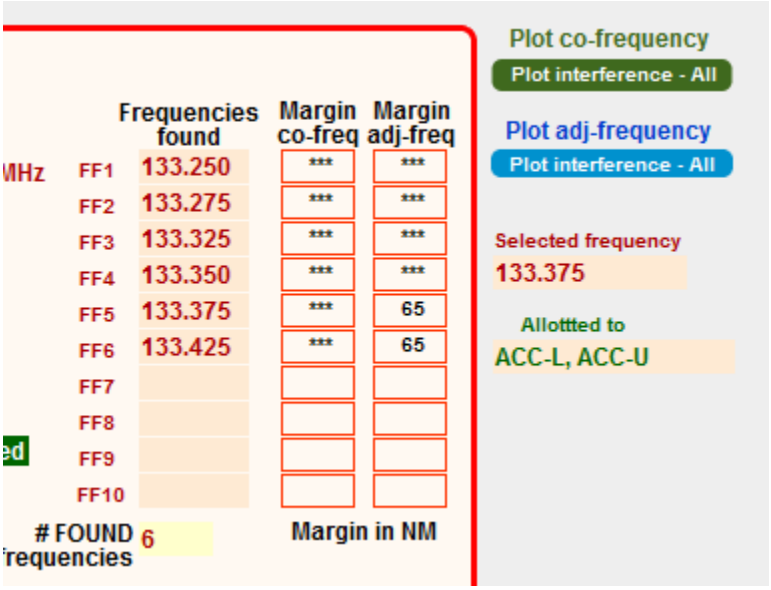
When the search is completed (Frequency Finder has found the required number of frequencies or has searched through the frequency range that has been set) FREQUENCY FINDER shows that the search is completed as follows (The frequency shown is the last frequency that was tested):

After the search for potential new frequency assignments has been completed, the frequency(ies) listed in the column **Frequencies found** show the compatible frequencies that were found. From this list, a frequency can be selected by the user.

To assist in the selection of a new or modified frequency assignment, for each potentially compatible frequency the compatibility margin with the nearest station is presented for both the co-frequency and adjacent frequency.

Ideally, to support efficient frequency assignment planning, the frequency with the lowest margin should be selected.

In the example shown above the frequency 133.375 MHz was selected as shown below:

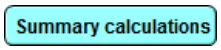


*Note: *** indicates that the frequency is not used within a range of 1020 NM from the station that is being tested.*

4.7.7.2.3 The selected frequency is shown in the field **Selected frequency** together with the allotment of this frequency as per the Regional Allotment Plan. At the same time when selecting a frequency, the box **Frequency** in the pane **Station** is updated with the selected frequency. No further testing is necessary since FREQUENCY FINDER has already tested compatibility of all frequency in the column **Frequencies found** with other frequency assignments in the Plan.

4.7.7.2.4 To view details of the test results for the selected frequency (119.425 MHz) the button "TEST" needs to be clicked. This starts (again) compatibility testing. The detailed test results will be available in the pane **Summary** after this testing is completed. TEST

Note: The pane summary only contains the detailed calculation results of the most recent compatibility calculations. In this example these are for the frequency 119.775 MHz.

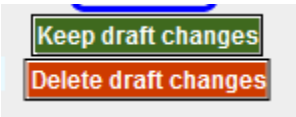
4.7.7.2.5 If necessary, more details of the calculation results can be viewed with the button 

on the toolbar (§ 4.7.2) as well as the summary results of all calculations that were made during the search . On the window **Summary Calculations**, the compatibility calculation results of all previous compatibility calculations (20) to find 8 frequencies as in the example are presented (See also §4.6.3; Test results)

4.7.8 Complete the selection of a new frequency assignment

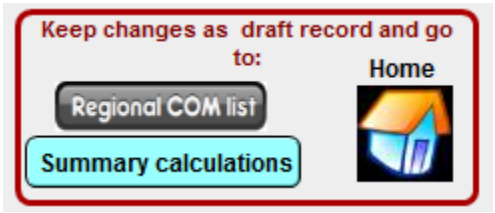
4.7.8.1 When a frequency has been determined to be acceptable this frequency can be permanently added to the VHF COM list by clicking the button 

Note: For a modified frequency, the old entry will be deleted from the VHF COM list and saved in a special list "Historical".



With the button "Keep draft changes" the new or the modified frequency assignment will be kept in the database as a draft record and return the COM list. This would enable coordination of the new or modified frequency while at the same time the draft frequency assignment is protected from interference that can be caused by later new or modified frequency assignments. At any time the user can convert the draft frequency assignment into a permanent frequency assignment with the button "**ENTER CHANGES**" (see above).

To cancel or delete the draft frequency assignment, click the button "Delete draft changes". No changes will be made to the VHF COM database.

To keep the changes as a draft frequency assignment that at a later time can be made permanent or deleted, use one of the buttons 

These buttons navigate from the window **NEW/MOD frequency** and keep the modifications in the database as a draft entry. This has the same effect as using the button: Keep draft changes".

5. Frequency assignment planning for VHF/UHF navigation aids (ILS, VOR, DME, GBAS)

(to be added)

6. Frequency assignment planning for LF/MF beacons (NDB and Locator)

(to be added)

7. Frequency assignment planning for High Frequency (HF) air/ground communication systems

(to be added)

8. Assignment planning for SSR Mode S Interrogator Identifier codes

(to be added)

9. Applications – VIEW ROUTES

Note: This application is subject to further updates with the view to increasing user friendliness use of it and to link it to other relevant ICAO data bases.

9.1. Introduction.

9.1.1 FREQUENCY FINDER has included a module **AIR ROUTES** that will allow the user to plot on a map the air routes. This module can be accessed from the start page of FREQUENCY FINDER with the VIEW ROUTES button or from inside the NAV module with the DME-DME button on the toolbar of the NAV frequency list.

9.1.1.1 The module has been included to

a. offer to the user to plot on the map the (selected) air routes

b. to calculate the number of DME stations along the air route within a predetermined range

c. to plot these DME stations on the map.

9.1.2 The current version has been included for evaluation and testing. Any comment that may improve the use of this module (e.g. for an assessment of RNAV DME-DME navigation) is welcome and will be incorporated in later version of this program.

9.1.3 The application VIEW ROUTES (currently) excludes from consideration DME stations that are associated with and ILS or an MLS. This has been implemented because of the typical short range of these DME stations (20 – 25 NM). However, in many cases frequency protection for DME associated with ILS or MLS can be arranged well beyond the range of the associated ILS or MLS facility which would increase the usefulness of these DME stations for RNAV. This exclusion may, at a later stage, be re-considered.

9.1.4 The **AIR ROUTES** module provides the user with the following options:

a. The user can select from the data base of air routes a single route segment with the button MAP ROUTE and plot this route segment on the map.

b. The user can query the data base (with the FIND button) to find all segments that belong to an air route or to find all routes in a square that can be determined by the user)

c. The user can calculate the coordinates of intermediate points along the route with a distance from the air route (or test points) that is determined by the user with the button Calculate test points

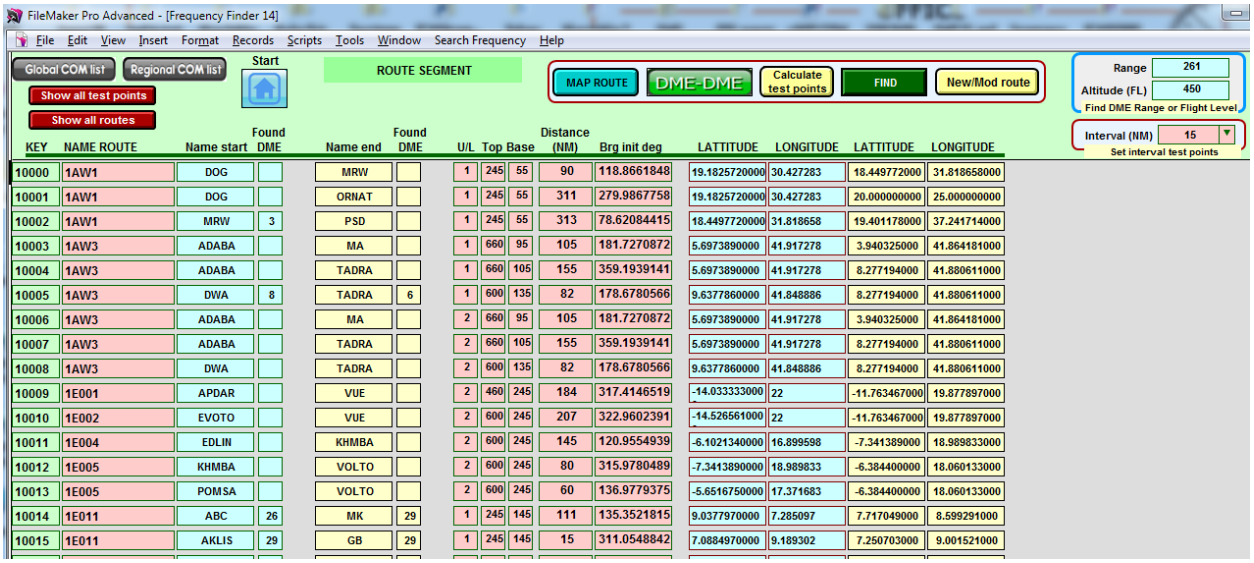
d. The user can determine (and plot on the map) the DME stations that are within a range along the air route with the button DME-DME; the range can be determined by the user. The DME stations are those contained in the NAV database.

e. The user can insert a new air route or modify the coordinates and other characteristics of existing route segments with the button New/Mod route .

Note: Depending on the feedback from the users, certain features can be added to or deleted from this module.

9.2. AIR ROUTE data base.

9.2.1 The module **AIR ROUTES** opens with the window ROUTE SEGMENT :



KEY	NAME ROUTE	Name start	Found DME	Name end	Found DME	U/L	Top	Base	Distance (NM)	Brg init deg	LATTITUDE	LONGITUDE	LATTITUDE	LONGITUDE
10000	1AW1	DOG		MRW		1	245	55	90	118.8661848	19.1825720000	30.427283	18.449772000	31.818658000
10001	1AW1	DOG		ORNAT		1	245	55	311	279.9867758	19.1825720000	30.427283	20.000000000	25.000000000
10002	1AW1	MRW	3	PSD		1	245	55	313	78.62084415	18.4497720000	31.818658	19.401178000	37.241714000
10003	1AW3	ADABA		MA		1	660	95	105	181.7270872	5.6973890000	41.917278	3.940325000	41.864181000
10004	1AW3	ADABA		TADRA		1	660	105	155	359.1939141	5.6973890000	41.917278	8.277194000	41.880611000
10005	1AW3	DWA	8	TADRA	6	1	600	135	82	178.6780566	9.6377860000	41.848886	8.277194000	41.880611000
10006	1AW3	ADABA		MA		2	660	95	105	181.7270872	5.6973890000	41.917278	3.940325000	41.864181000
10007	1AW3	ADABA		TADRA		2	660	105	155	359.1939141	5.6973890000	41.917278	8.277194000	41.880611000
10008	1AW3	DWA		TADRA		2	600	135	82	178.6780566	9.6377860000	41.848886	8.277194000	41.880611000
10009	1E001	APDAR		VUE		2	460	245	184	317.4146519	-14.033333000	22	-11.763467000	19.877897000
10010	1E002	EVOTO		VUE		2	600	245	207	322.9602391	-14.526561000	22	-11.763467000	19.877897000
10011	1E004	EDLIN		KHMBA		2	600	245	145	120.9554939	-6.1021340000	16.899598	-7.341389000	18.989833000
10012	1E005	KHMBA		VOLTO		2	600	245	80	315.9780489	-7.3413890000	18.989833	-6.384400000	18.060133000
10013	1E005	POMSA		VOLTO		2	600	245	60	136.9779375	-5.6516750000	17.371683	-6.384400000	18.060133000
10014	1E011	ABC	26	MK	29	1	245	145	111	135.3521815	9.0377970000	7.285097	7.717049000	8.599291000
10015	1E011	AKLIS	29	GB	29	1	245	145	15	311.0548842	7.0884970000	9.189302	7.250703000	9.001521000

9.2.2 The database for air routes includes the following information:

Key Unique key number for each route segment

Name route Name of the route (a single route can consist of multiple segments having the same name)

Name start Name of the start of the route segment (this can be a 5-letter name code or the 3-letter identification of a navaid marking the start of the route segment)

Found DME Found DME – in case calculations were undertaken to determine the number of DME surrounding the start point, this field contains that number

Name end Name of the end of the route segment (this can be a 5-letter name code or the 3-letter identification of a navaid marking the end of the route segment)

Found DME Found DME – in case calculations were undertaken to determine the number of DME surrounding the end point, this field contains that number

U/L 1 if the route is an upper route, 2 if the route is a lower route (In case the upper and lower route have the same characteristics, the route segment is entered twice in the data base.

Top Upper level of the air route segment

Base Lower level of the air route segment

Distance (NM) Distance between the start and the end point of the route segment

Bearing init deg. Bearing from the start point to the end point of the route segment (degrees)

Latitude start Latitude of the start point of the route segment

Longitude start Longitude of the start point of the route segment

Latitude end Latitude of the end point of the route segment

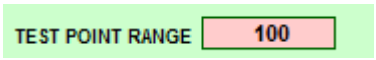
Longitude end Longitude of the end point of the route segment

Note: In the final version, some of the fields in this table may be deleted as they have been primarily inserted to support developing the module.

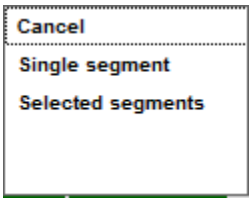
9.2.3 With 

the button each single route segment or a selection of route segments (e.g. As a result of a query) can be plotted on the map.
The button 

calculates the number of DME around the start and the end point of each single route segment within a circle with a radius (NM) that has been set by the user in the field



9.2.3.1 When clicking these buttons, a drop-down menu offers the user to select a single route segment, the selection of route segment or to cancel:

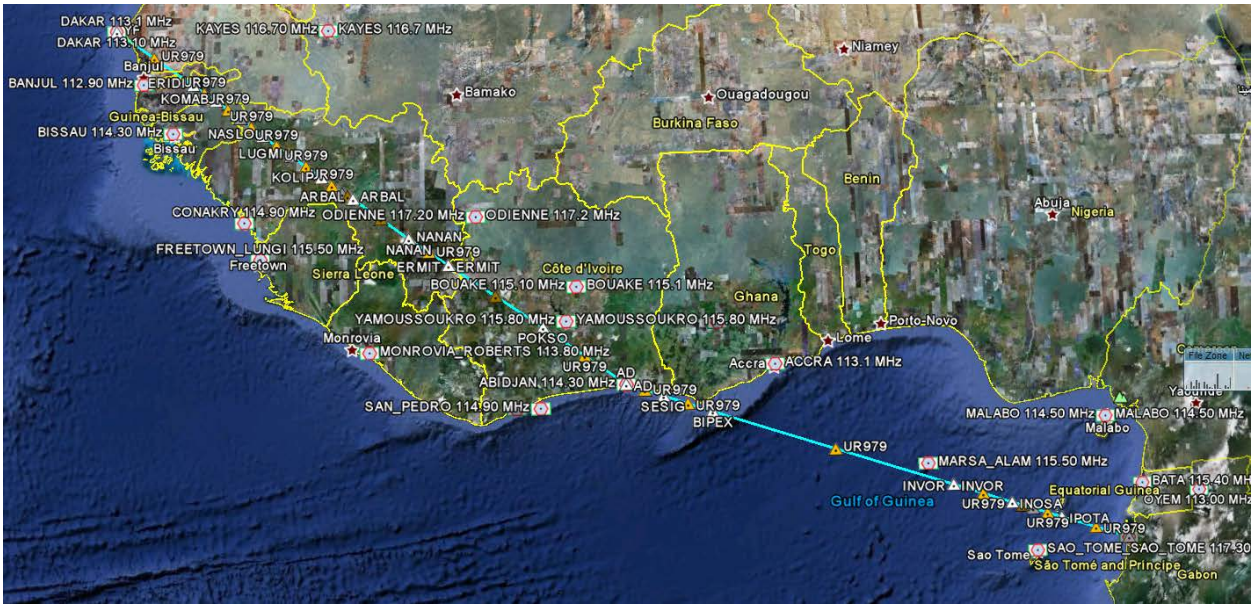


9.2.4 In the example below, four DME stations have been found within a range of 200 NM from the route segment for air route UR979 and the segment between KOLIP and LUGMI. Note that the DME Bissau is entered twice on this map. This is because this DME has been entered twice in the data base of frequency assignments. Updates to the DME data base are in progress.

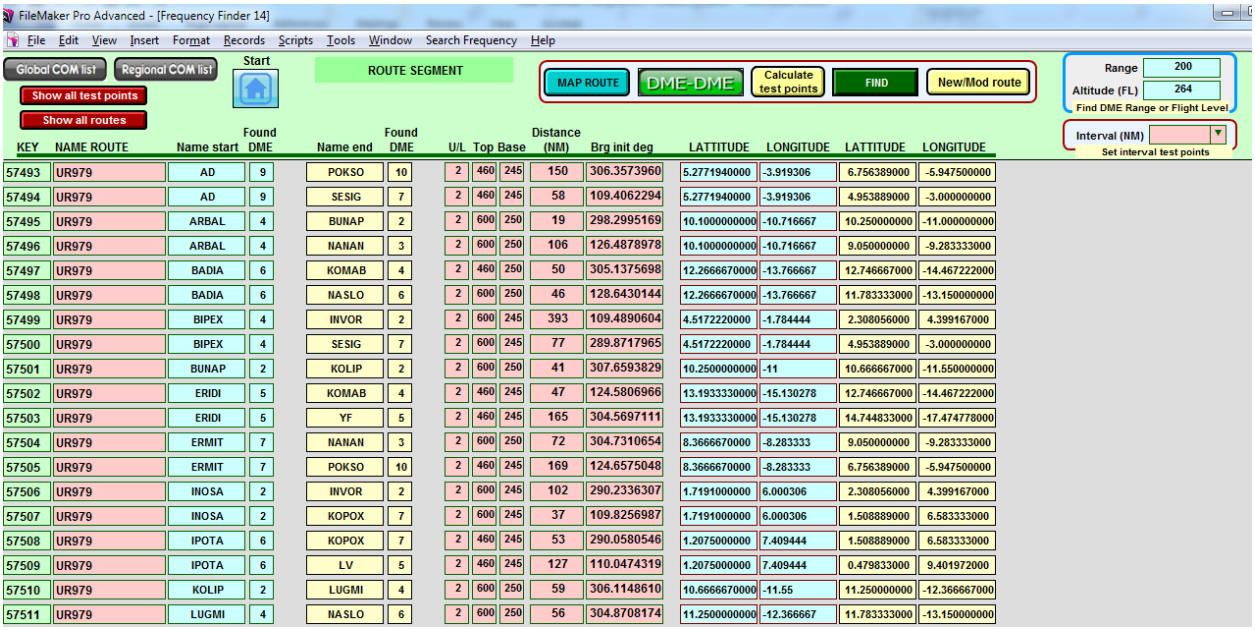
9.2.4.1 The route segment is plotted as a blue line, the start and end point of this route is marked with the relevant identifications KOLIP and LUGMI.

9.2.4.2 As the route segments that together build an air route are relatively small, the program offers, *inter alia*, the opportunity to the user to identify a whole air route and plots this on a map, with the DME along this route as required.

9.2.4.3 The following shows the whole of air route UR979 and the DME around each start and endpoint of each route segment within a range of 200 NM.



9.2.4.4. When the number of DME stations around the start and end points has been calculated, this information is inserted in the data base in the fields Found DME.

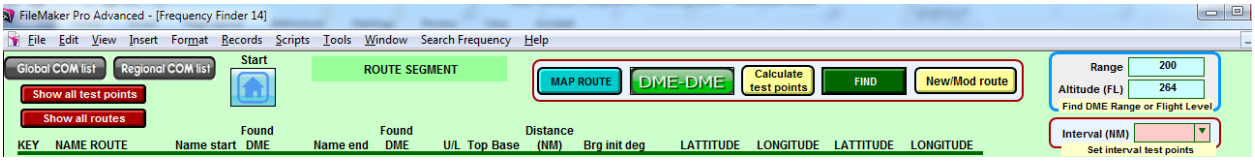


KEY	NAME ROUTE	Name start	Found DME	Name end	Found DME	U/L	Top	Base	Distance (NM)	Brg init deg	LATTITUDE	LONGITUDE	LATTITUDE	LONGITUDE
57493	UR979	AD	9	POKSO	10	2	460	245	150	306.3573960	5.2771940000	-3.919306	6.756389000	-5.947500000
57494	UR979	AD	9	SESIG	7	2	460	245	58	109.4062294	5.2771940000	-3.919306	4.953889000	-3.000000000
57495	UR979	ARBAL	4	BUNAP	2	2	600	250	19	298.2995169	10.1000000000	-10.716667	10.250000000	-11.000000000
57496	UR979	ARBAL	4	NANAN	3	2	600	250	106	126.4878978	10.1000000000	-10.716667	9.050000000	-9.283333000
57497	UR979	BADIA	6	KOMAB	4	2	460	250	50	305.1375698	12.2666670000	-13.766667	12.746667000	-14.467222000
57498	UR979	BADIA	6	NASLO	6	2	600	250	46	128.6430144	12.2666670000	-13.766667	11.783333000	-13.150000000
57499	UR979	BIPEX	4	INVOR	2	2	600	245	393	109.4890604	4.5172220000	-1.784444	2.308056000	4.399167000
57500	UR979	BIPEX	4	SESIG	7	2	600	245	77	289.8717965	4.5172220000	-1.784444	4.953889000	-3.000000000
57501	UR979	BUNAP	2	KOLIP	2	2	600	250	41	307.6593829	10.2500000000	-11	10.666667000	-11.550000000
57502	UR979	ERIDI	5	KOMAB	4	2	460	245	47	124.5806966	13.1933330000	-15.130278	12.746667000	-14.467222000
57503	UR979	ERIDI	5	YF	5	2	460	245	165	304.5697111	13.1933330000	-15.130278	14.744833000	-17.474778000
57504	UR979	ERMIT	7	NANAN	3	2	600	250	72	304.7310654	8.3666670000	-8.283333	9.050000000	-9.283333000
57505	UR979	ERMIT	7	POKSO	10	2	460	245	169	124.6575048	8.3666670000	-8.283333	6.756389000	-5.947500000
57506	UR979	INOSA	2	INVOR	2	2	600	245	102	290.2336307	1.7191000000	6.000306	2.308056000	4.399167000
57507	UR979	INOSA	2	KOPOX	7	2	600	245	37	109.8256987	1.7191000000	6.000306	1.508889000	6.583333000
57508	UR979	IPOTA	6	KOPOX	7	2	460	245	53	290.0580546	1.2075000000	7.409444	1.508889000	6.583333000
57509	UR979	IPOTA	6	LV	5	2	460	245	127	110.0474319	1.2075000000	7.409444	0.479833000	9.401972000
57510	UR979	KOLIP	4	LUGMI	4	2	600	250	59	306.1148610	10.6666670000	-11.55	11.250000000	-12.366667000
57511	UR979	LUGMI	4	NASLO	6	2	600	250	56	304.8708174	11.2500000000	-12.366667	11.783333000	-13.150000000

Note: The actual range of the DME station is currently not considered in this summary. The actual range for the DME needs to be calculated on the basis of the Designated Operational Range and the actual altitude (Flight Level) which is being considered. This will be incorporated in further updates to these calculations.

9.3. Functionality (toolbar)

The main AIR ROUTE table offers the following functionality through buttons in the toolbar:

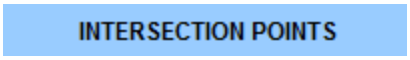


The button Global COM list returns to the Global NAV data base of frequency assignments.

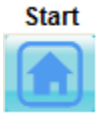
The button Regional COM list returns to the Regional COM list of NAV frequency assignments

Note: Buttons to return to the Global/Regional list of VHF COM frequency assignments and other data bases included in the program **FREQUENCY FINDER** *need to be added.*

This button shows all route segments in the AIR ROUTE data base.

This button takes the user to the window 

where the results of earlier calculations for test points is shown.



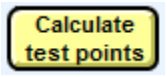
This button returns to the start page of the program.

This button opens a new window where the user can either modify an existing route segment or insert a new air route.

In the red box, the following three buttons provide for functions that apply to either the selected (single) route segment or the selection of route segments (e.g. as a result of a query or FIND).

Plots the selected (single) route segment or (queried) route segments on the map.

Calculates and plots the found DME stations at the start and end-point of the route segment or route segments on the map. The range is set by the user in the field **Range** or **Altitude**

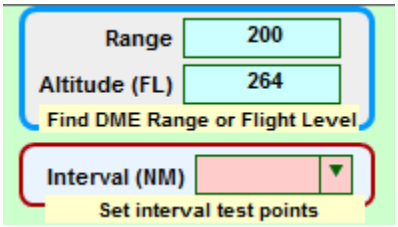


Calculates test points in between the start and end point of the route segment or route segments along the route segment. The distance between the test points is set by the user in the field **Interval.** Also all test points and the DME stations around these test points can be plotted on the map.
The choice by the user to initiate the action by these buttons for a single route segment or a series of route segments can be made by the relevant drop-down menus that will pop-up when clicking these buttons. (See §9.6)

This button opens a window where the user can query the data base. (See §9.5)

This button start the process to introduce a new route or to modify an existing route segment. (See §9.4)

Input parameters



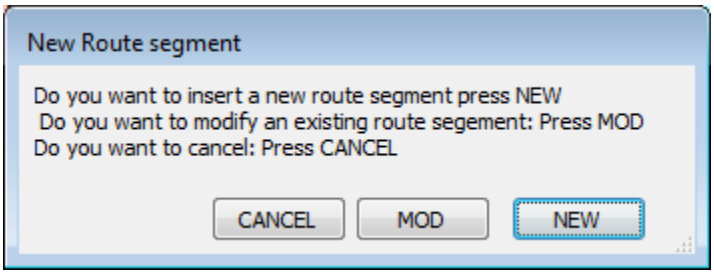
Range The user can set the range from within DME stations are to be found. Alternatively, the user can set the flight level of the aircraft from where DME stations within the radio horizon are to be found.

Interval The user can set the interval for the test points along a route segment (NM).

Maintenance Provides maintenance functions, e.g. import a new updated data base of all route segments from the relevant ICAO data base. Not to be used.

9.4 New/Mod route

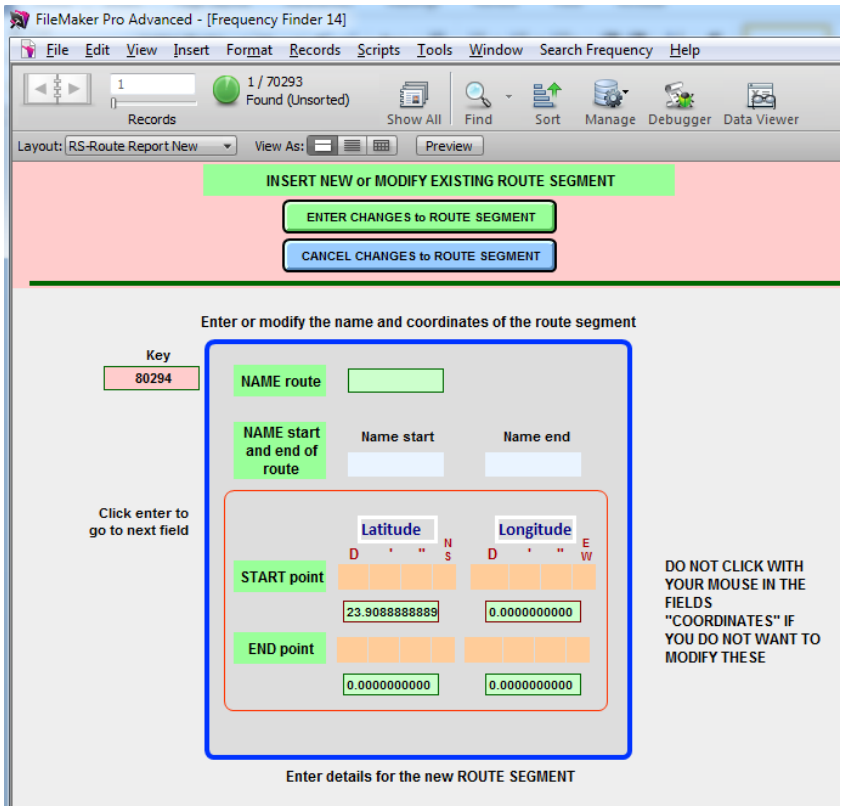
9.4.1 The button New/Mod route triggers the pop-up menu:



The user can select to modify an existing route segment (the route segment that was active when the button New or modify route segment was clicked) with the button **MOD** or to enter a new route segment with the button **NEW**.

9.4.1.1. NEW route segment

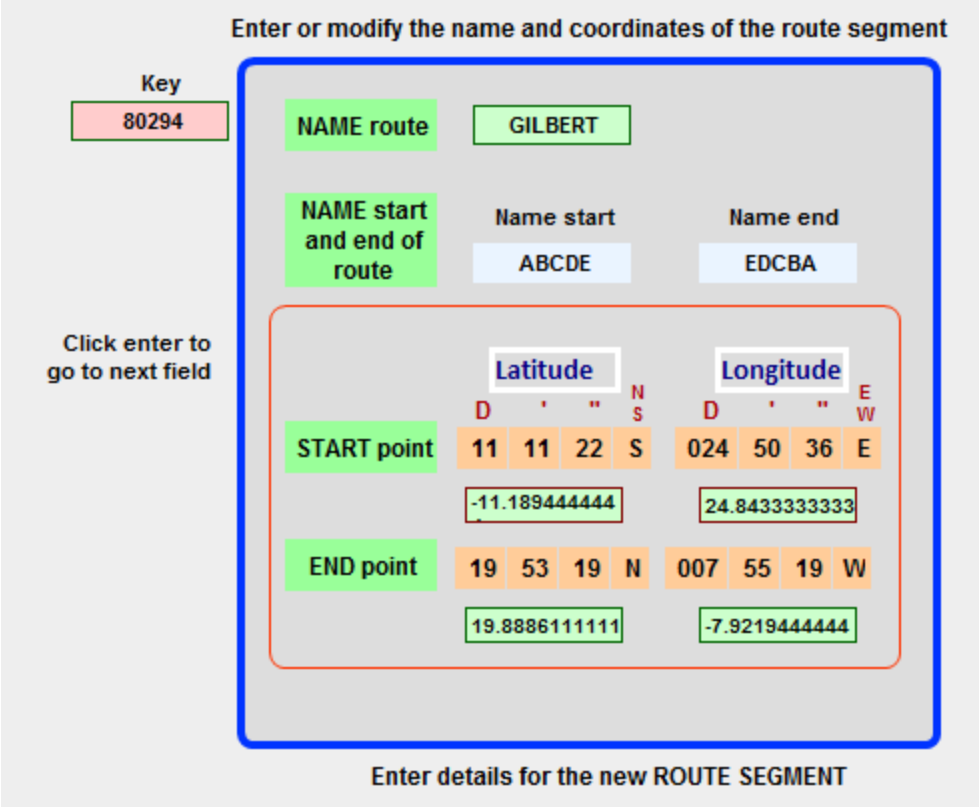
Clicking **NEW** on the pop-up menu shows the window INSERT NEW or MODIFIED ROUTE SEGMENT:



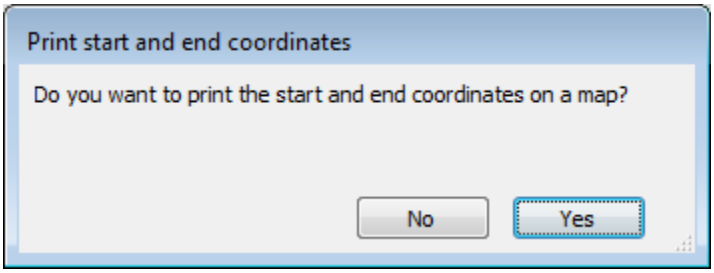
The new route segment has already been provided with a Key by the program. The user can insert the name of the route, the name of the start and end point (e.g. a 5-letter name code) and the coordinates of the start and end point of the route segment:

Note: In a future version, the insertion of a new Route Segment will be linked to the relevant tables that identify the start and end point of a route segment (e.g. NAV tables or 5 letter name code tables.

In the example below, a new route segment with route name GILBERT, start point ABCDE and end point EDCBA has been entered with the coordinates 111122S and 0245036E for the start point of the route and 195319N and 0075519W. FREQUENCY FINDER converts these into decimal degrees.



Clicking the button **ENTER CHANGES to ROUTE SEGMENT** will insert the new route segment in the database. The user will be invited through a pop-up menu to plot the new route on the map.

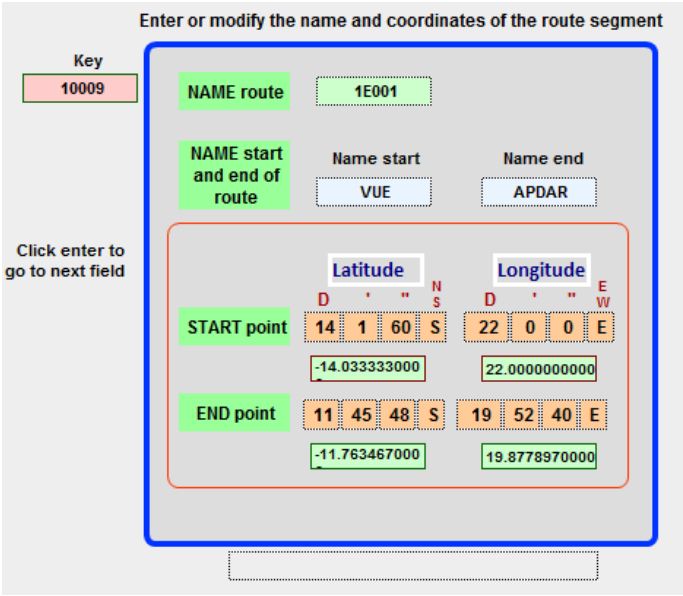


Clicking yes will plot the above example as follows:

The button **CANCEL CHANGES to ROUTE SEGMENT** will cancel the procedure; the database will not be updated.

9.4.1.2 Modified route segment.

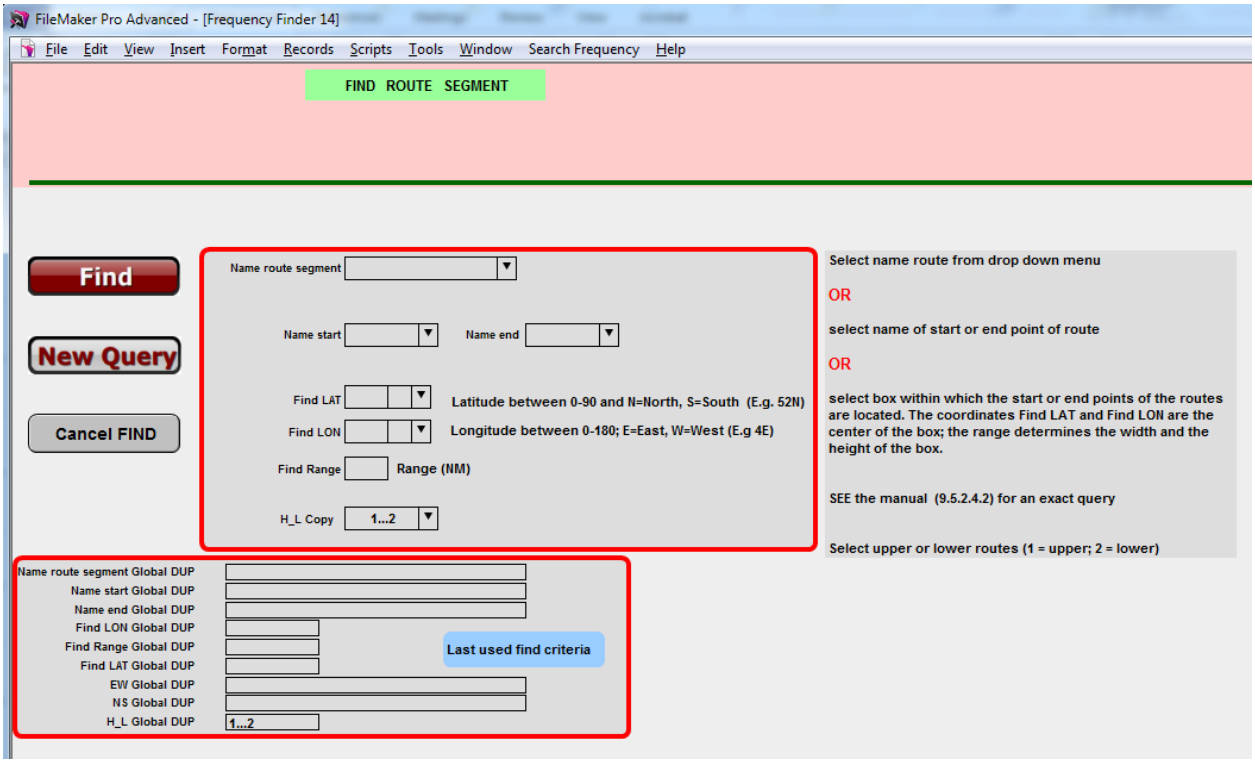
When clicking on the pop-up menu (see paragraph 4.1) MOD for modified route segment, the following windows shows:



The Key, the name of the route, the name of the start and end points as well as their coordinates have been inserted. The user can modify these as described in paragraph 4.1.

9.5 

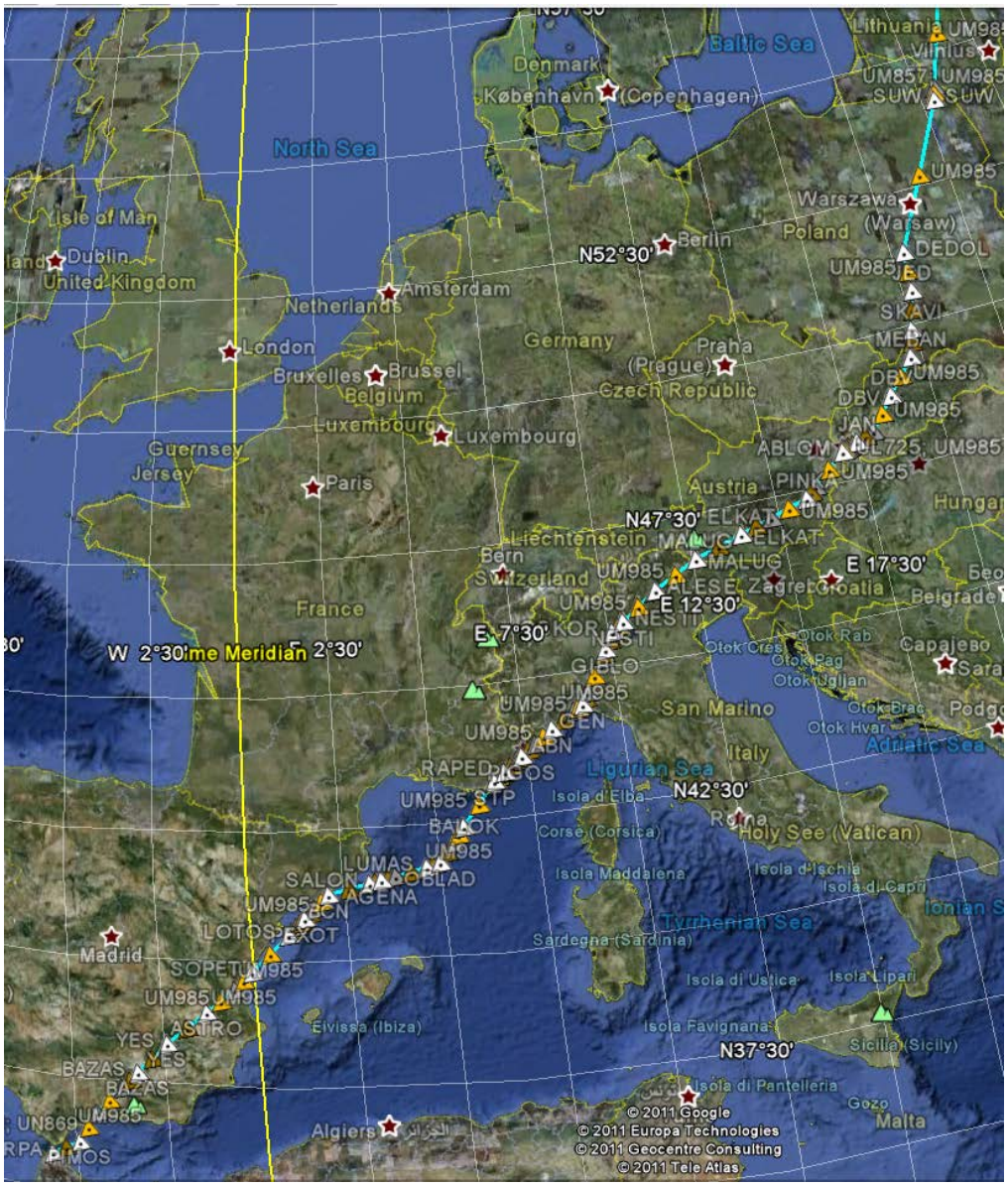
9.5.1 Clicking the button **FIND** will open the window **FIND ROUTE SEGMENT** from where the user can query the database.



9.5.2 Through this window the user can search the data base with the following parameters:

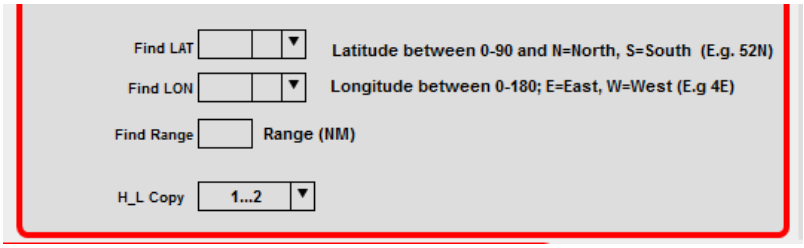
9.5.2.1 Name route segment – entering a name of the route segment (or the air route) will return ALL entries in the database with the same name for the route segment. This will normally bring all segments that together form an air route.

Example: When typing UM 985 in the box Name route segment, the program finds 58 entries in the database that together form the route UM985. Plotting these on the map shows the following route:



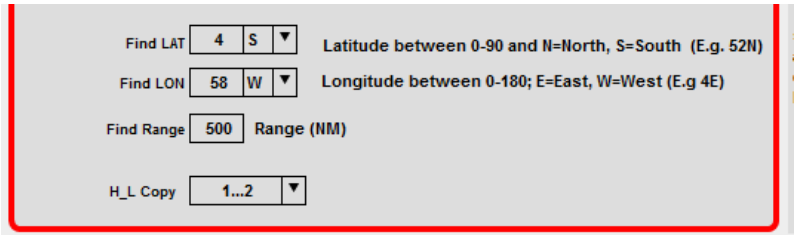
9.5.2.2 Alternatively, the user can search for route segments with a particular start- or end name.

9.5.2.3 The last option is to search for air routes in a geographical area.

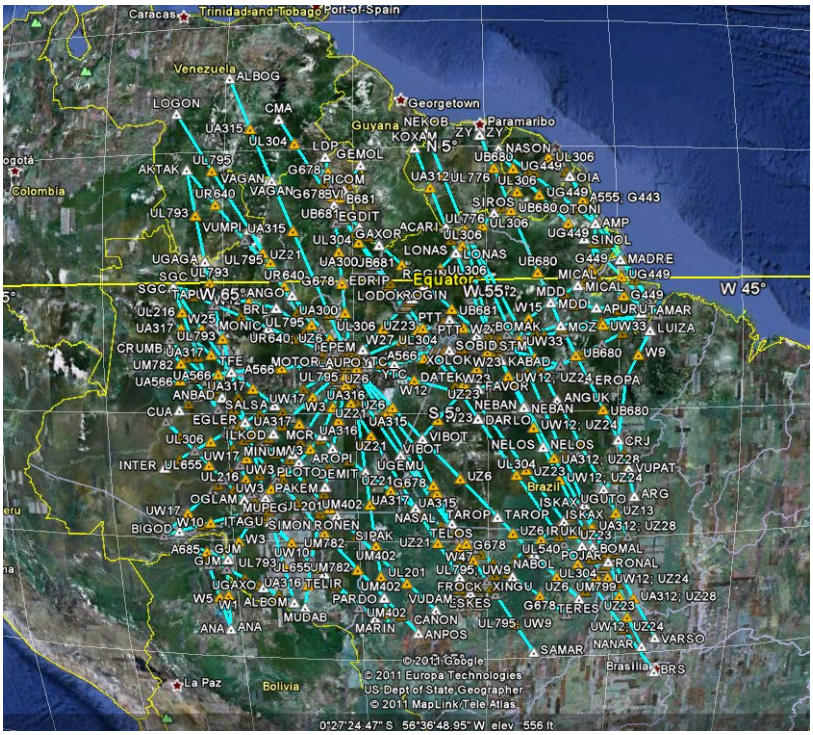


In the boxes **Find LAT** and **Find LON** the user can insert the geographical coordinates (only DD or DDD, no minutes or seconds) of the center of the box within which the search for route segments is initialized.
In the box **Find Range** the user can insert the range around these coordinates where the user wants to search for route segments.
In the box **H_L copy** the user can select if the search is only for upper routes (1, only for lower routes (2) or both (1…2). The selection is through a drop-down menu. Once these parameters are entered, the user can find these route segments with the button Find

Example: Coordinates 4 S and 58 W, a range of 500 NM and both upper and lower routes (1…2) will find 383 route segments that have either the start point or the end point in the square around these coordinates



Plotting these with the button **MAP ROUTE** in the red box on the toolbar of the database (window **ROUTE SEGMENT**) will plot these air routes on the map as follows:



9.5.2.4 IMPORTANT:

9.5.2.4.1 These search options (and those in 5.3) are mutually exclusive; the data base can only be queried with one parameter at a time.

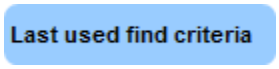
9.5.2.4.2 Entering a search option for the Name route segment or Name start / end will find ALL entries which include that name. E.g. searching for route R2 will find all entries for route R2 but also R22, R219 etc. To find ONLY routes with the name R2, the search option in the relevant box needs to be preceded with ==, e.g. entering ==R2 will only find routes with the name R2.

9.5.2.5 Other buttons on the window **FIND ROUTE SEGMENT**:

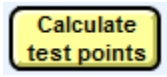
After the parameters for the search or query have been entered, clicking the button **Find** will start the execution of the query.

With the button **New Query**, a new query is possible.

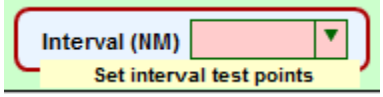
With the button Cancel Find, the query will be terminated and the program returns to the window ROUTE SEGMENT.



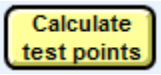
With the button **Last used find criteria** the user can copy the criteria of the most recent query into the relevant boxes and redo the most recent query.

9.6. 

9.6.1 The button **Calculate test points** will start the calculation of the coordinates of intermediate point along a single route segment. From the drop down menu the user can select to calculate the coordinates for test points of a single route segment or a selection of route segments.

Important: Before starting the calculation of the coordinates for the intermediate points, the user needs to set on the window ROUTE SEGMENT the interval in the box 

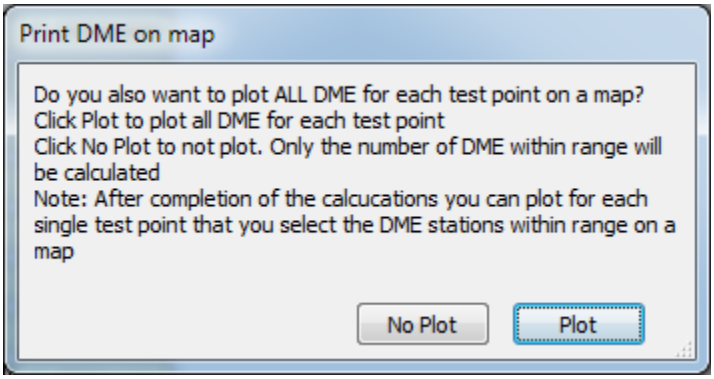
This interval sets the distance between the intermediate points and distributes them evenly over the length of the route segments. The distance set is in NM.

9.6.1.1 When 

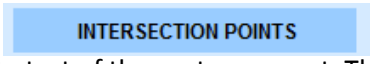
the button has been clicked and the user has selected from the drop down menu to calculate the coordinates of test points along the route segment, the program will start to calculate the coordinates of these test points. As a first step the program will plot the route segment or selected route segments on the map. These route segment are marked by triangles on the map. The program further offers the user through a pop-up box to plot (or not plot) the DME stations within 'range" of the test points on the map.

Note: §9.6.3. describes the calculation of test points and DME station within range for a selection of (more than one) route segments.

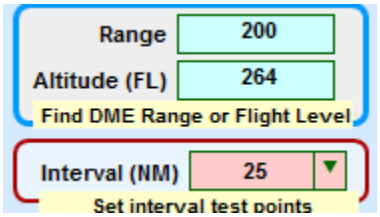
9.6.1.2 A pop-up dialog box invites the user to either plot on the map all found DME for each of the test or intermediate points that are in the list or to NOT plot the DME stations within "range" of each test point at this point in time.



9.6.1.3 Clicking **No Plot** in the dialog box will result in each test point to be plotted on the map, but **NOT** the DME stations around these points. The program however calculates for each test point the number of DME stations within "range" and lists the found number in the column **Found DME**.

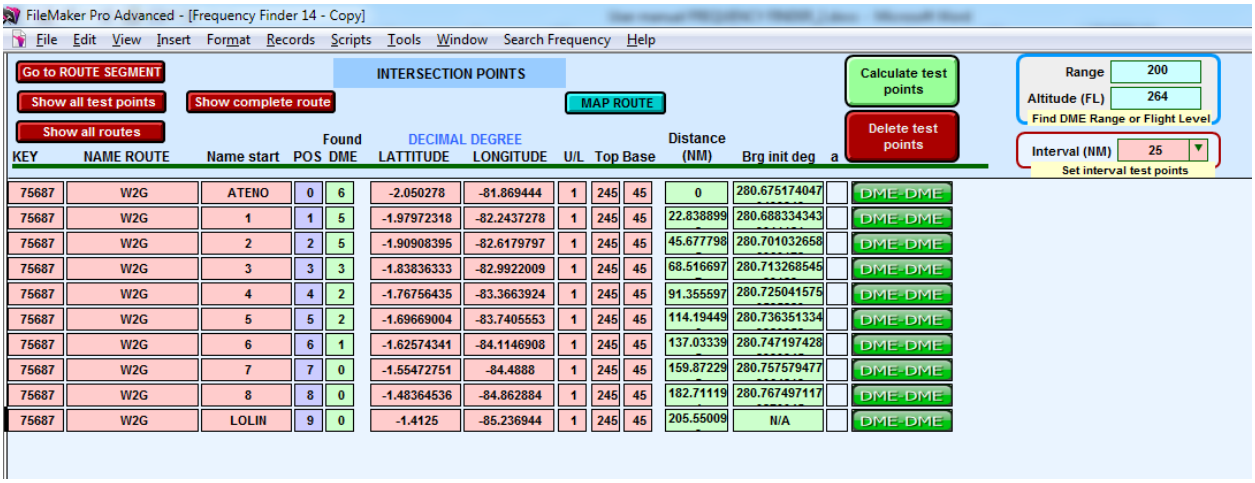
9.6.1.4 The new 

window shows the list with the start, the end and the newly calculate test of the route segment. These points have, in the example below, the numbers 0 to 9; the first and the last point include the name of the start and the end point of the route segment.



Note that in this example the field **Range** has been set to 200 NM (the program will find all DME stations within a range of 200 NM from each test point) and the field **Interval** to 25 NM (test points are separated by about 25 NM from each other). The number of found DME stations for each test point is presented in the list.

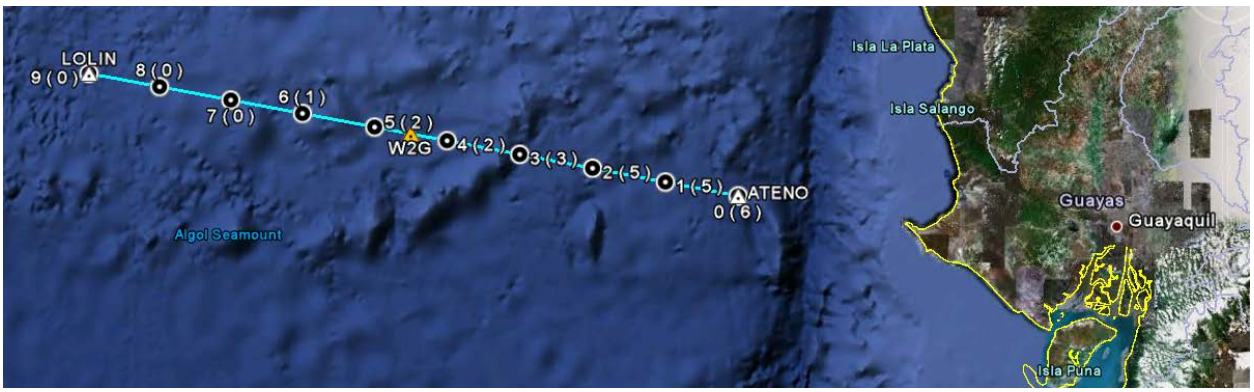
Note: When a range is entered the program presents the Flight Level applicable to the range (distance) to the radio horizon. Entering a Flight Level will present the range to the radio horizon.



KEY	NAME ROUTE	Name start	POS	Found DME	DECIMAL DEGREE LATTITUDE	LONGITUDE	U/L	Top	Base	Distance (NM)	Brg init deg	a	
75687	W2G	ATENO	0	6	-2.050278	-81.869444	1	245	45	0	280.675174047		DME-DME
75687	W2G	1	1	5	-1.97972318	-82.2437278	1	245	45	22.838899	280.688334343		DME-DME
75687	W2G	2	2	5	-1.90908395	-82.6179797	1	245	45	45.677798	280.701032658		DME-DME
75687	W2G	3	3	3	-1.83836333	-82.9922009	1	245	45	68.516697	280.713268545		DME-DME
75687	W2G	4	4	2	-1.76756435	-83.3663924	1	245	45	91.355597	280.725041575		DME-DME
75687	W2G	5	5	2	-1.69669004	-83.7405553	1	245	45	114.19449	280.736351334		DME-DME
75687	W2G	6	6	1	-1.62574341	-84.1146908	1	245	45	137.03339	280.747197428		DME-DME
75687	W2G	7	7	0	-1.55472751	-84.4888	1	245	45	159.87229	280.757579477		DME-DME
75687	W2G	8	8	0	-1.48364536	-84.862884	1	245	45	182.71119	280.767497117		DME-DME
75687	W2G	LOLIN	9	0	-1.4125	-85.236944	1	245	45	205.55009	N/A		DME-DME

9.6.1.5 The (cumulative) distance of the start point to the intermediate point is presented in the column **Distance (NM)**. The column **Brg init deg** contains the bearing for each intermediate point to the end point (LOLIN in the example) of the route segment. Other data in this list is as contained in the data base of air routes.

9.6.1.6 The test or intermediate points are plotted on the map as black and white circles:



9.6.1.7 For each test point (including the start and end point) the number of the position of the test point (column **POS** in the table) is plotted with the test point. The number in between brackets represents the number of found DME within "range of this test point. In this example, the "range" was set to 200 NM; the interval to 25 NM.

9.6.1.8 The user can now continue and select a single test point, and plot the DME stations on the map by clicking the button DME-DME against a single test point. Clicking against test point 2 in the example above will show the following 5 DME stations on the map:

In this manner the user can plot for each test point the DME stations within range on the map and evaluate the found DME stations for each test point..

The button Show all routes will bring the user back to the main window ROUTE SEGMENT and show all route segments in the database.

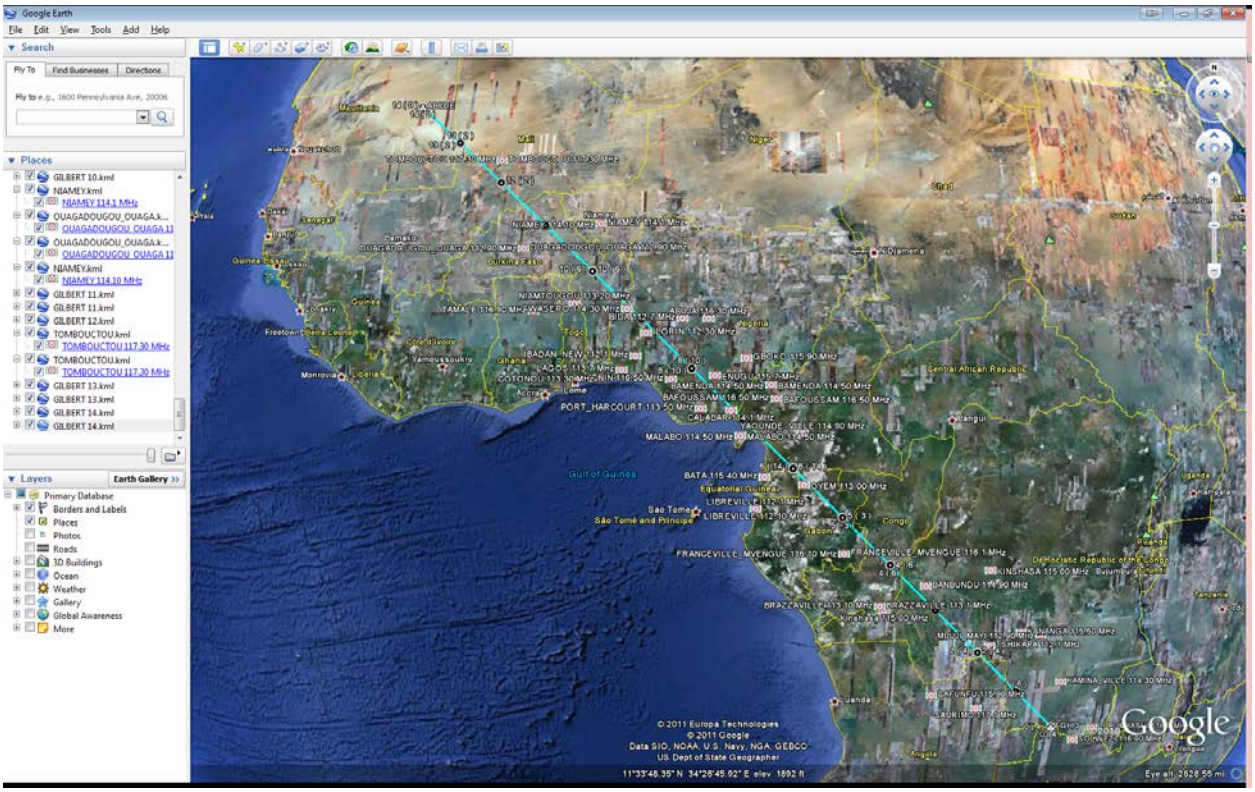
The button Show all test points shows all calculated test points, including those that were calculated earlier.

The button Go to ROUTE SEGMENT will return to the window ROUTE SEGMENT but will keep the results of any query.

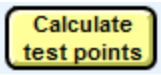
The button MAP ROUTE will plot on the map only the route and the start and end points.
Note: This button may be removed since when calculating the test points also the route itself is plotted.

Should the user wish to re-calculate the test points and the found DME stations with different parameters for **RANGE** and / or **Interval**, new parameters can be entered in the relevant boxes on the toolbar and the re-calculation can start with the button Calculate test points .

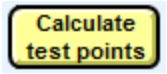
9.6.2 If the user in the pop-up window in paragraph 9.6.1.2 has decided to plot all DME stations for the whole route segment on the map, All DME stations within range for each test or intermediate point will be shown as in the following picture:



9.6.2.1 It may however be difficult to identify which DME stations are within "range" by which test point. Therefore, for a more detailed analysis, the method whereby for each test point separately the DME stations within "range" are plotted on the map separately may be preferred.

9.6.3 Selecting 

the button will calculate and plot on the map all intermediate point for a selection of route segments. A selection can be a series of route segments that has been identified as a result of a query.

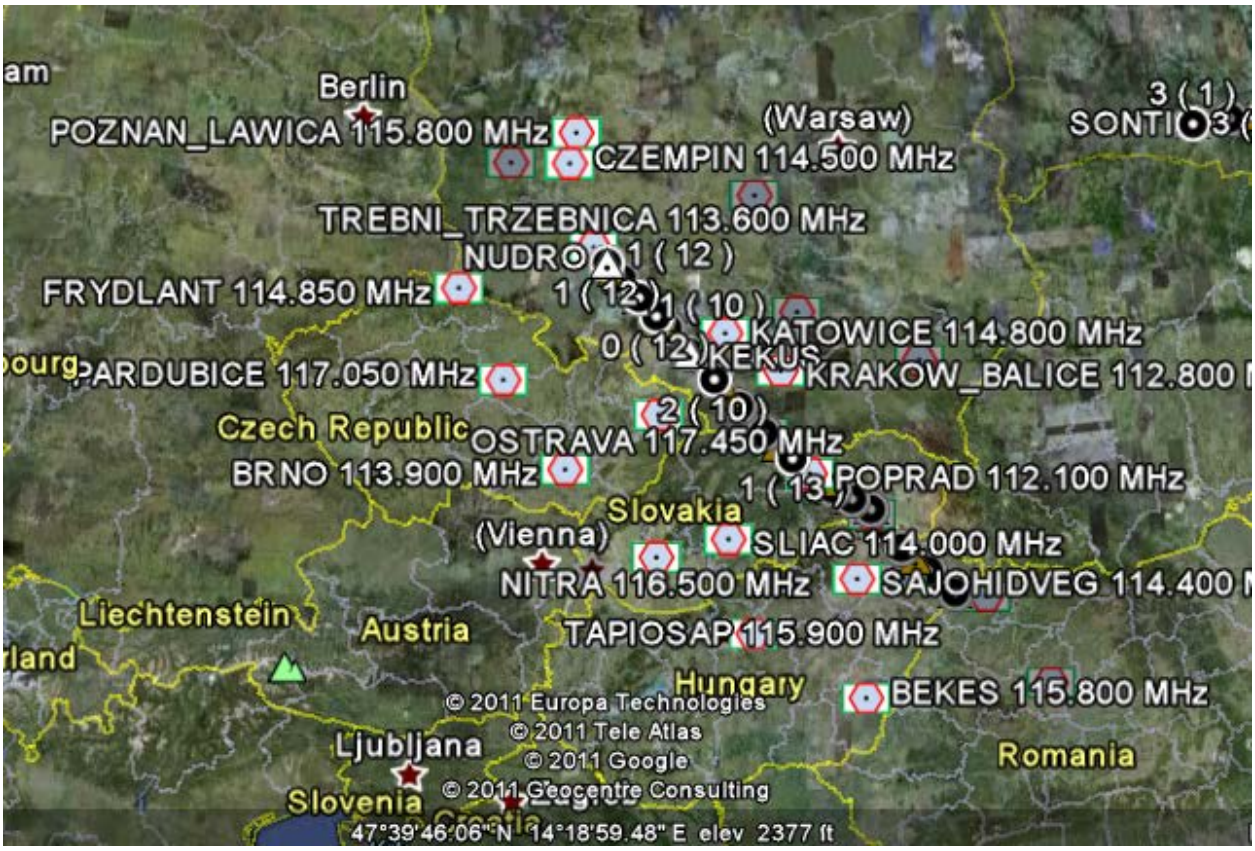
9.6.3.1 In the following example the data base has first been queried for the air route R232. (Exact find, preceded by ==). The box **TEST POINT RANGE** is set to 100 NM and the box **Interval (NM)** is set to 25 NM.
With the button 

the user will initially be requested to plot (or not) the DME stations around this route on the map through a pop-up menu. Selecting "No Plot" will calculate for each route segment the intermediate points and the number of DME stations within the range (100 NM) and selecting plot will show all DME stations around the air route R232 within a range of 100 NM. After the calculations are completed, only the last calculated route segment is shown in the table on the layout **INTERSECTION POINTS**. All route segments of the selected route can be shown with the button: 

. The whole route R232 is built up out of 10 different route segments.

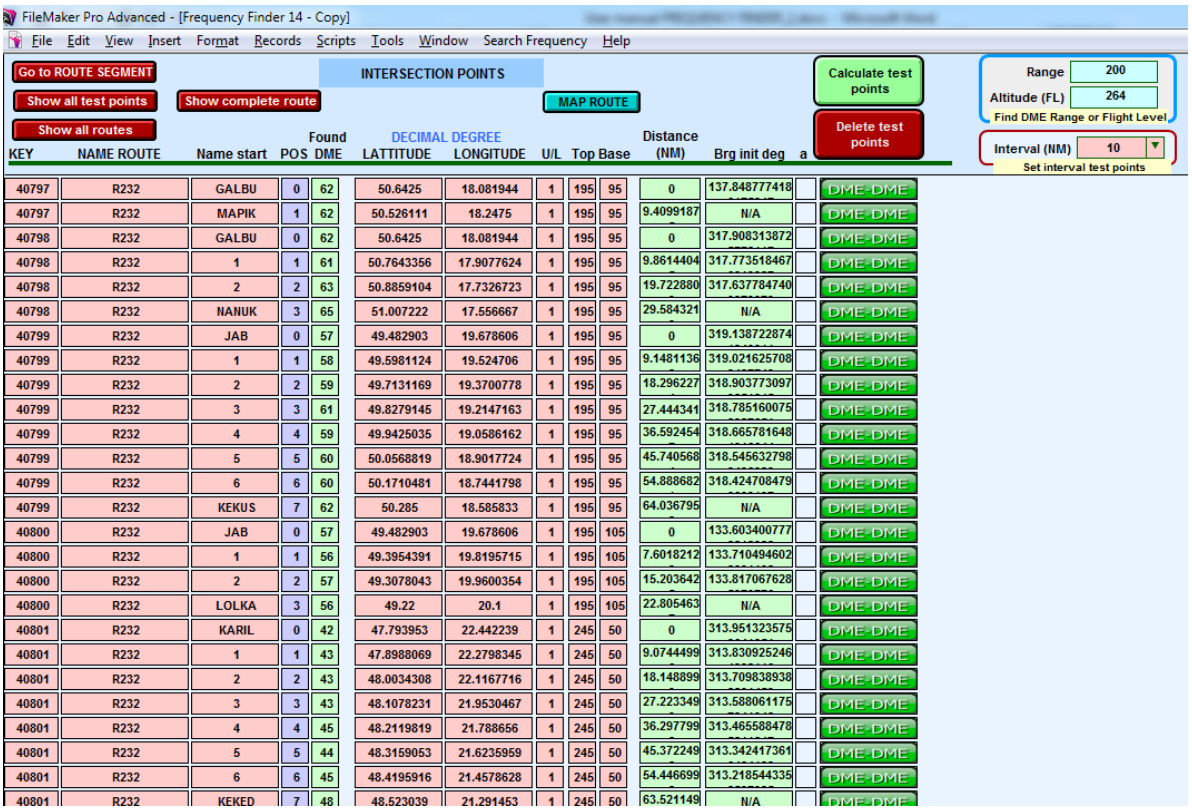
Note: Caution should be taken to select the right route segment. Route segments (or routes) do not have a unique name in the global database of air routes and when selecting a particular route, in several countries an air route with the same name may be selected by the program.

9.6.3.2 In the example below, the route segments, the test points and all DME within the range (100 NM) of each test point are plotted on the map.



9.6.2.3 The table below shows the calculation results for each test point. This table shows the individual test point, the number of DME stations within range for each test point and the coordinates for each test point.

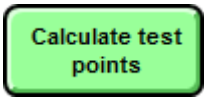
9.6.2.3.1 Should the user wish to examine the location of DME stations for a single test point, the Google Earth map should be emptied (right click on Google Earth / Temporary Places and select Delete Contents) first. After this, the user can click a single test point in the table with the button DME-DME which will plot the test point only as well as the DME stations around this test point. With the button MAP ROUTE the user can also plot the air route on the map.



KEY	NAME ROUTE	Name start	POS	Found DME	DECIMAL DEGREE LATTITUDE	LONGITUDE	U/L	Top	Base	Distance (NM)	Brg init deg	a	
40797	R232	GALBU	0	62	50.6425	18.081944	1	195	95	0	137.848777418		DME-DME
40797	R232	MAPIK	1	62	50.526111	18.2475	1	195	95	9.4099187	N/A		DME-DME
40798	R232	GALBU	0	62	50.6425	18.081944	1	195	95	0	317.908313872		DME-DME
40798	R232	1	1	61	50.7643356	17.9077624	1	195	95	9.8614404	317.773518467		DME-DME
40798	R232	2	2	63	50.8859104	17.7326723	1	195	95	19.722880	317.637784740		DME-DME
40798	R232	NANUK	3	65	51.007222	17.556667	1	195	95	29.584321	N/A		DME-DME
40799	R232	JAB	0	57	49.482903	19.678606	1	195	95	0	319.138722874		DME-DME
40799	R232	1	1	58	49.5981124	19.524706	1	195	95	9.1481136	319.021625708		DME-DME
40799	R232	2	2	59	49.7131169	19.3700778	1	195	95	18.296227	318.903773097		DME-DME
40799	R232	3	3	61	49.8279145	19.2147163	1	195	95	27.444341	318.785160075		DME-DME
40799	R232	4	4	59	49.9425035	19.0586162	1	195	95	36.592454	318.665781648		DME-DME
40799	R232	5	5	60	50.0568819	18.9017724	1	195	95	45.740568	318.545632798		DME-DME
40799	R232	6	6	60	50.1710481	18.7441798	1	195	95	54.888682	318.424708479		DME-DME
40799	R232	KEKUS	7	62	50.285	18.585833	1	195	95	64.036795	N/A		DME-DME
40800	R232	JAB	0	57	49.482903	19.678606	1	195	105	0	133.603400777		DME-DME
40800	R232	1	1	56	49.3954391	19.8195715	1	195	105	7.6018212	133.710494602		DME-DME
40800	R232	2	2	57	49.3078043	19.9600354	1	195	105	15.203642	133.817067628		DME-DME
40800	R232	LOLKA	3	56	49.22	20.1	1	195	105	22.805463	N/A		DME-DME
40801	R232	KARIL	0	42	47.793953	22.442239	1	245	50	0	313.951323575		DME-DME
40801	R232	1	1	43	47.8988069	22.2798345	1	245	50	9.0744499	313.830925246		DME-DME
40801	R232	2	2	43	48.0034308	22.1167716	1	245	50	18.148899	313.709838938		DME-DME
40801	R232	3	3	43	48.1078231	21.9530467	1	245	50	27.223349	313.588061175		DME-DME
40801	R232	4	4	45	48.2119819	21.788656	1	245	50	36.297799	313.465588478		DME-DME
40801	R232	5	5	44	48.3159053	21.6235959	1	245	50	45.372249	313.342417361		DME-DME
40801	R232	6	6	45	48.4195916	21.4578628	1	245	50	54.446699	313.218544335		DME-DME
40801	R232	KEKED	7	48	48.523039	21.291453	1	245	50	63.521149	N/A		DME-DME

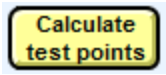
9.6.2.3.2 For example, when clicking the button DME-DME next to test point 1 of the route segment KARIL – KEKED (Key # 40801) the DME and VOR/DME within range will be plotted on the map as follows:

(The route of this particular route segment can be plotted by using the button MAP ROUTE)

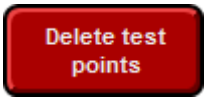
9.6.3 The button 

allows the user to re-calculate the test point for a **SINGLE** route segment. When the user clicks a test point of a certain route segment, the test points and the number of DME stations will be re-calculated in accordance with the parameters set in the box **RANGE or Altitude** and the box **Interval (NM).**

Note: The test points for the whole route (all route segments) can be re-calculated returning to the window by returning to the window 

, performing a query with the exact name of the route segments, insert the revised calculation parameters and clicking the button 

(See paragraph 9.6.3 above).

9.6.4 The button 

will delete all calculations of test points from the data base and can be used in case these calculations are no longer required to be kept in the database.

9.7. Final remarks.

Should this module be considered as useful for RNAV and DME-DME navigation analyses, the following functionality can be added:

A For each of the test points, a separate list can be created that contains all the DME stations found for each test point, and include the bearing relative to the DME seen from the test point.
B. The list also identifies whether the DOC range of the DME is within the range of the test point.
C. Plot around a test point a circle with the range of the test point, which makes it easier to identify the DME stations within range of a test point.
D. A circle (or keyhole) that represents the actual DOC of the DME.

And most likely any other functionality you would like to see added.

It is important to note that the DOC of the DME, as specified in the COM list does actually not represent the real coverage of the DME. For instance, a DME with a range of 200 NM can provide service (in theory) down to flight level 250 (at this altitude the radio horizon is at about 200 NM. Below flight level 250, the DME provides only coverage at shorter distances (e.g. for FL 100, the radio horizon is at 123 NM.

When identifying DME stations that can be used for RNAV applications, the lowest operational use for a given geographical area (e.g. air route) needs to be considered.

Coverage of a DME should be based on a more sophisticated model (compare to the current used free space propagation model) that can determine the propagation losses along the radio path. One such a tool is the IF 77 model that has been developed by the FAA. It is the intention that this model at a later stage be incorporated in the program in order to better calculate the link budget for navigation and communication systems.

Appendix A

ICAO CONTRACTING STATES

Afghanistan	Haiti	San Marino
Albania	Honduras	Sao Tome and Principe
Algeria	Hungary	Saudi Arabia
Andorra	Iceland	Senegal
Angola	India	Serbia
Antigua and Barbuda	Indonesia	Seychelles
Argentina	Iran (Islamic Republic of)	Sierra Leone
Armenia	Iraq	Singapore
Australia	Ireland	Slovakia
Austria	Israel	Slovenia Solomon Islands
Azerbaijan	Italy	Somalia
Bahamas	Jamaica	South Africa
Bahrain	Japan	Spain
Bangladesh	Jordan	Sri Lanka
Barbados	Kazakhstan	Sudan
Belarus	Kenya	Suriname
Belgium	Kiribati	Swaziland Sweden
Belize	Kuwait	Switzerland
Benin	Kyrgyzstan	Syrian Arab Republic
Bhutan	Lao Peoples Democratic Republic	Tajikistan
Bolivia	Latvia	Thailand
Bosnia and Herzegovina	Lebanon	The former Yugoslav Republic of Macedonia
Botswana	Lesotho	Timor-Leste
Brazil	Liberia	Togo
Brunei Darussalam	Libyan Arab Jamahiriya	Tonga
Bulgaria	Lithuania	Trinidad and Tobago
Burkina Faso	Luxembourg	Tunisia
Burundi	Madagascar	Turkey
Cambodia	Malawi	Turkmenistan
Cameroon	Malaysia	Uganda
Canada	Maldives	Ukraine
Cape Verde	Mali	United Arab Emirates
Central African Republic	Malta	United Kingdom
Chad	Marshall Islands	United Republic of Tanzania
Chile	Mauritania	United States
China	Mauritius	Uruguay
Colombia	Mexico	Uzbekistan
Comoros	Micronesia (Federated States of)	Vanuatu
Congo	Monaco	Venezuela
Cook Islands	Mongolia	Viet Nam
Costa Rica	Montenegro	Yemen
Côte dIvoire	Morocco (*)	Zambia
Croatia	Mozambique	Zimbabwe
Cuba	Myanmar	
Cyprus	Namibia	
Czech Republic	Nauru	
Democratic Peoples Republic of Korea	Nepal	
Democratic Republic of the Congo	Netherlands	
Denmark	New Zealand	
Djibouti	Nicaragua	
Dominican Republic	Niger	
Ecuador	Nigeria	
Egypt	Norway	
El Salvador	Oman	
Equatorial Guinea	Pakistan	
Eritrea	Palau	
Estonia	Panama	
Ethiopia	Papua New Guinea	
Fiji	Paraguay	
Finland	Peru	
France	Philippines	
Gabon	Poland	
Gambia	Portugal	
Georgia	Qatar	
Germany	Republic of Korea	
Ghana	Republic of Moldova	
Greece	Romania Russian Federation	
Grenada	Rwanda	
Guatemala	Saint Kitts and Nevis	
Guinea	Saint Lucia	
Guinea-Bissau	Saint Vincent and the Grenadines	
Guyana	Samoa	

Appendix B

Services and designated operational coverage

Source: ICAO Handbook on Radio Frequency Spectrum Requirements (DOC 9718), Volume II

B.1 Services

B.1.1 Frequency assignments are made to implement specific aeronautical services as follows:

Aerodrome
TWR Aerodrome control service
AS Aerodrome surface communications
AFIS Aerodrome flight information service

Approach
APP Approach control service
ATIS Automatic terminal information service

En route
FIS Flight information service
ACC Area control service

Other functions
A/A Air-to-air
A/G Air-to-ground
AOC Aeronautical operational control
VOLMET Meteorological broadcast for aircraft in flight
GPS VHF En-Route General Purpose System
EM Emergency
SAR Search and rescue

B.2 Coordination of special frequencies

No frequency coordination of frequency assignment planning is necessary for the emergency frequency (121.500 MHz) and the SAR frequency (123.100 MHz) as these services are available globally at each station where this service is required. The provisions in Annex 10 include a guard band for these frequencies to prevent adjacent channel interference. Also, no specific frequency assignment planning is required for the air-to-air communication channel 123.450 MHz as this channel is to be used only in remote and oceanic areas when the aircraft is out of the coverage of VHF ground stations.

B.3 Table of uniform values for designated operational coverage (DOC)

B.3.1 Frequencies for aeronautical radio communication services are (normally) implemented to satisfy the operational need for specific services. These services, and their uniform designated operational coverage areas, are as in Table B-1.

Service	Designated Operational Coverage (DOC)			Mode
	Range (NM)	Height (ft)	Comments	
Aerodrome				
TWR	25	4000	Height above ground	A/G
TWR/L	16	3000	Height above ground; only in EUR	
PAR	25	4000	Height above ground	A/G
AFIS	25 EUR: 15	4000 EUR: 3000	Height above ground	A/G
AS	Limits of aerodrome	Surface		A/G
Approach				
APP–L	50 EUR: 25	12000 10000		A/G
APP–I	75 EUR: 40	25000 EUR: 15000		A/G
APP–U	150 EUR: 50	45000 EUR: 25000		A/G
En-Route				
ACC–L	Area	25000	Within specified area; max range155 NM**	A/G
ACC-LL	EUR: Area	15000	Within specified area; max range120 NM**	
ACC-I	Area	25000 EUR: 35000	Within specified area; max range 130 NM** Within specified area; max range 185 NM**	A/G
ACC–U	Area	45000	Within specified area; max range 200 NM**	A/G
FIS-L	Area	25000	Within specified area; max range 155 NM**	A/G
FIS or FIS-U	Area	45000 EUR: 23000	Within specified area; max range 200 NM** Within specified area; max range 120 NM**	A/G
VOLMET	200	45000	Maximum range 200 NM*	BC
Other functions				
ATIS	200 EUR: 60	45000 EUR: 20000		BC
A-A	200	45000	Maximum range 200 NM**	A/G
A-G	200	45000	Maximum range 200 NM**	A/G
AOC	100	250	Not protected; max. range 100 NM	A/G
EM	N/A	N/A	No frequency coordination required	A/G
SAR	N/A	N/A	No frequency coordination required	A/G
GPS	200	45000	Maximum range 200 NM**	A/G

Table B-1 Table of uniform designated operational coverage

Notes:

i. *Designated operational coverage marked with ** are reduced to 80% of the distance to the radio horizon in case no maximum range is provided. (see also paragraph Doc. 9718, Vol. II, § 2.6.4)*
ii. *Different DOC areas may be specified by States*
iii. *DOC for AOC only provided to enable compatibility assessment when frequencies for AOC are shared with ATC services; different DOC may be specified.*
iv. *For area services, no frequency protection is provides outside the specified area.*
v. *Unless specified by States, the DOC for A-A and A-G is assumed at 45000 ft. / 200 NM*
vi. *Mode: A/G: air/ground communications; BC: (ground) broadcast communications*

B.3.2 Additional functionality concerning the use of these services in the column "comments" may be added to the services as follows:

CD	Clearance delivery
CTA	Control area
DF	Direction finding
ER	Extended range
PAR	Precision Approach Radar
RCAG	Remote controlled air-ground communications
SR	Surveillance Radar

These additions do not alter the basic service or the DOC for which the frequency is required and should be included as a remark to the frequency assignment in the COM list in the global table of frequency assignments.

Certain services may not require protection because they are not in operation to provide safety-of-life service (e.g. for Gliders, Balloons). However, when these services are shared with ATC services, a compatibility analysis is required (see also paragraph 2.7.2.5.3).

B.3.3 Non-standard DOC (Range and Height) may be implemented as and when required. Reduced DOC, where operationally acceptable, may alleviate frequency congestion.

B.3.4 The use of common frequencies, preferably Region wide, to satisfy requirements for specific non-protected applications such as light aviation, gliding and balloon activities is recommended as such use increases the efficiency in frequency assignment planning.

B.3.5 Frequencies for aeronautical operational control are not protected through frequency planning. These frequencies are normally assigned on the basis of the traffic loading that is expected. (E.g. within the same area, smaller airlines can share the same frequency for operational control purposes).

B.4 Coverage at very low angles from ground transmitter

B.4.1 Due to the vertical polar diagram of the antenna of the ground station, at very low angles the radiation of the transmitted energy is too low to provide coverage over a large area Also, the distance to the aircraft decreases if the angle of the radio path with the horizontal plane through the ground antenna increases. As an example, for an aircraft operating at 45000 ft., the distance to the ground transmitter decreases as shown in Table B-2.(4/3 Earth radius).

Angle (degree)	*Distance (NM)* Height: 45000 ft.	*Distance (NM)* Height 25000 ft.	*Distance (NM)* Height 4000 ft.
0 (radio horizon)	*261*	*195*	*78*
.1	*252*	*186*	*70*
.2	*245*	*178*	*63*
.3	*237*	*171*	*57*
.4	*230*	*164*	*52*
.5	*223*	*158*	*74*
.6	*217*	*152*	*43*
.7	*210*	*146*	*40*
.8	*204*	*140*	*37*
.9	*198*	*135*	*34*
1	*192*	*130*	*32*

Table B-2 Distance as function of angle above horizon

The geometry used in these calculations is shown in Figure B-1

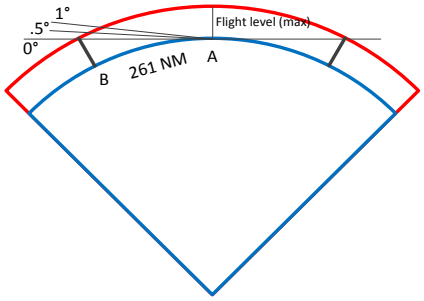


Figure B-1 Reduction in distance to the transmitter when receiving above the horizontal plane through the ground antenna

On the basis of the principles in 2.6.4.1, in case for certain services no actual maximum Designated Operational Range has been specified, the maximum operational range within which frequency protection is provided can be about 80% of the distance to the radio horizon. For certain of these services, a maximum operational range has been incorporated in table 2-5.

It is recognized that States may require different values for the designated operational coverage from the uniform values in Table 2-5 for certain services.

Note: Application is to be decided on a Regional level

B.5 Interference from FM broadcasting stations

The risk of interference from FM broadcasting stations operating in the band 87 – 108 MHz is generally not considered for frequency assignments in the band 117.975 – 137 MHz.

B.6 Co-location of facilities

ICAO frequency assignment planning does not include protection against interference that may be caused in case facilities are co-located (e.g. interference due to intermodulation products). During the installation of COM systems the COM service provider needs to prevent such cases of interference (e.g. by using cavity filters).

B.7 Coordination of frequency assignments

Frequency coordination must take place with all States which may be affected by a proposal for a new frequency assignment or where the characteristics of an existing assignment are modified.

Normally, such coordination is effected through the ICAO Regional Offices which have a central and coordinating role in frequency assignment planning.

Definitions for designated operational range, height and coverage

Designated operational range or height (DOR or DOH) – The range or height to which an aid is needed operationally in order to provide a particular service and within which the facility is afforded frequency protection.

Note 1 – The designated value for range or height is determined in accordance with the criteria for the deployment of the aid in question.

Note 2 – The designated value for range or height forms the basis for the technical planning of aids.

Designated operational coverage (DOC) – The combination of the designated operational range and the designated operational height (e.g. 200NM/FL500 is the designated operational coverage for an aid with a designated operational range of 500 NM and a designated operational height of 50.000 ft (Flight Level 500).

Appendix C

C.1 Table of separation distances for VHF Communication systems (Source: Doc 9718, Volume II)

Separation distances are between the edge of the designated coverage areas

		VICTIM											
	Service	TWR 25/4000	AFIS 25/4000	AS Surface	APP-U 150/450	APP- I 75/250	APP-L 50/120	ACC-U Area/450	ACC-L Area/250	FIS-U Area/450	FIS- L Area/250	VOLMET 260/450	ATIS 200/450
INTERFER	TWR	156	156		338	273	212	338	273	338	273	338	338
	AFIS	156	156		338	273	212	338	273	338	273	338	338
	AS (Note 2)			25									
	APP-U	338	338		520	455	394	520	455	520	455	520	520
	APP-I	273	273		455	390	329	325	390	455	390	455	455
	APP-L	212	212		394	329	268	394	329	394	329	394	394
	ACC-U (Note 1)	338	338		520	455	394	520	455	520	455	520	520
	ACC-L (Note 1)	273	273		455	390	329	455	390	455	390	455	455
	FIS-U (Note 1)	338	338		520	455	394	520	455	520	455	520	520
	FIS-L (Note 1)	273	273		455	390	329	455	390	455	390	455	455
	VOLMET	338	338		520	455	394	520	455	520	455	15	15
	ATIS	338	338		520	455	394	520	455	520	455	15	15

Table C-1 Minimum geographical co-frequency separation distances between stations

Note 1: All distances are in NM.

Note 2: Frequencies for aerodrome surface communications should be selected from the band 121.600 – 121.975 MHz. This band is reserved exclusively for aerodrome surface communications. No separation distances with other services are provided. Should it be necessary to share frequencies for AS with air/ground communication services, the minimum geographical separation distance can be calculated as shown in paragraph 2.7.2.1.1 and assuming a designated operational coverage for aerodrome surface communications of 5 NM/100 ft.

C.2 In the EUR Region, the table of separation distances (table C.2 below) has been developed, taking into account:

i. Different values for the uniform designated operational coverage (see Appendix B).

ii. Application of the separation-distance ratio method (5:1) using the D/U protection ratio of 14 dB.

For information purposes, this table is reproduced below.

Service	AFIS/TWR 16/3000	TWR 25/4000	APP-U 50/250	APP- I 40/150	APP-L 25/100	ACC-U Area/450	ACC-I Area/350	ACC-L Area/250	ACC/LL Area/150	VOLMET 271/450	ATIS 60/02050
AFIS/TWR	*80*	*125*	*250*	*200*	*125*	328	297	261	218	328	241
TWR	*125*	*125*	*250*	*200*	*125*	339	308	272	229	339	252
APP-U	*250*	*250*	*250*	*250*	*250*	455	424	388	345	455	*300*
APP-I	*200*	*200*	*250*	*200*	*200*	412	381	345	302	412	*300*
APP-L	*125*	*125*	*250*	*200*	*125*	384	353	317	274	384	297
ACC-U (Note 1)	328	339	455	412	384	522	491	455	412	522	*300*
ACC-I (Note 1)	297	308	424	381	353	491	460	424	381	491	*300*
ACC-L (Note 1)	261	272	388	345	317	455	424	388	345	455	*300*
ACC-LL	218	229	345	302	274	412	381	345	302	412	*300*
VOLMET	328	339	455	412	384	522	491	455	412	10	211
ATIS	241	252	*300*	*300*	297	*300*	*300*	*300*	*300*	211	124

Table C-2 EUR Table of separation distances

Notes:

i. Separation distances in NM.

ii. All distances in red/italics have been calculated using the 5:1 distance ratio. Other separation distances are limited to the radio horizon.

iii. Separation distances between VOLMET and ATIS were calculated assuming an antenna height of the VOLMET/ATIS transmitter of 65 ft. (20m)

C.3 Separation distances for VDL (VDL Mode 2 and VDL Mode 4)

VDL operating co-frequency with other VDL or VHF COM voice systems

The same planning criteria as used between VHF voice systems (20 dB protection ratio) should be used. The separation criteria are those as described in paragraph 2.7.2. The designated operational coverage for VDL Mode 2 and VDL Mode 4 facilities need to be separated from the designated operational coverage of a co-frequency VHF-COM voice (DSB-AM) system with at least the distance to the radio horizon of each service. .

Note: This applies also to frequency assignments between VDL facilities.

C.3.1 VDL operating on adjacent frequencies with other VDL or VHF COM voice systems

The 1st frequency, adjacent (25 kHz) to either a DSB-AM frequency or a VDL frequency should not be used in the same airspace.

The 2nd frequency, adjacent (25 kHz) to a DSB-AM frequency should not be used in the same airspace for VDL Mode 4.

		Interference source		
		DSB-AM	VDL 2	VDL 4
Victim	DSB-AM		1	2
	VDL 2	1	1	1
	VDL 4	2	1	1

Table Error! No text of specified style in document.**-1 25 kHz guard band (channels) between DSB-AM, VDL mode 2 and VDL mode 4 (air-air)**

Note: The numbers in Table 4 are guard-bands (channels). The next frequency that can be used without frequency planning constrain is 1 channel higher (e.g. a desired DSB-AM station that is interfered by a VDL Mode 2 aircraft station requires one 25 kHz guard band.. The next frequency, 50 kHz away, can be used in the same designated operational coverage without any frequency assignment planning constraint.

Operation of VDL on the surface of an airport

Attention is drawn to the possibility of interference between DSB-AM and VDL Mode 2/4 when these systems are used on the surface of an airport. The following adjacent channel constraints have been developed under the assumption that the minimum separation between an aircraft on the surface of an airport and the ground station (transmitter/receiver) is at least 210 m. This is considered a realistic scenario at most airports. However, aircraft at the surface of an airport can be separated at closer ranges. Protection has been considered at the minimum required field strength and calculations have been made assuming free space propagation conditions. Measurements at a number of representative airports showed that in many cases the minimum fields strength is about 10 – 12 dB higher than the minimum required.

On the basis of an analysis performed by the Aeronautical Communications Panel, the following frequency assignment planning constraints (Table C-3) have been developed for VDL Mode 2 and VDL Mode 4, when operating with aircraft on the surface of an airport.

		Interference source		
		DSB-AM	VDL 2	VDL 4
Victim	DSB-AM	-	4	4
	VDL 2	4	1	1
	VDL 4	4	1	1

Table C-3 25 kHz guard band (channels) between DSB-AM and VDL (modes 2 and 4) on the surface of an airport

Interference can occur if the frequency separation between a VDL frequency assignment (guard band) is four channels (25 kHz) or less. In this case interference between aircraft stations can be prevented through securing that the minimum field strength of these systems is at least 70 dBm at the antenna. Any interference that may be caused in ground based receiving stations (i.e. not aircraft stations) can be mitigated through using cavity filters that block in these receivers the reception of unwanted signals from transmissions from aircraft operating on the surface of an airport.

Note: Detailed information is available in the documents VDL Frequency Assignment Planning Criteria (117.975 – 137 MHz) and VDL Mode 4 and VOR compatibility (112 – 117.975 MHz) which can be downloaded from the ACP Website (http://legacy.icao.int/anb/panels/acp/repository.cfm) in the Repository section.

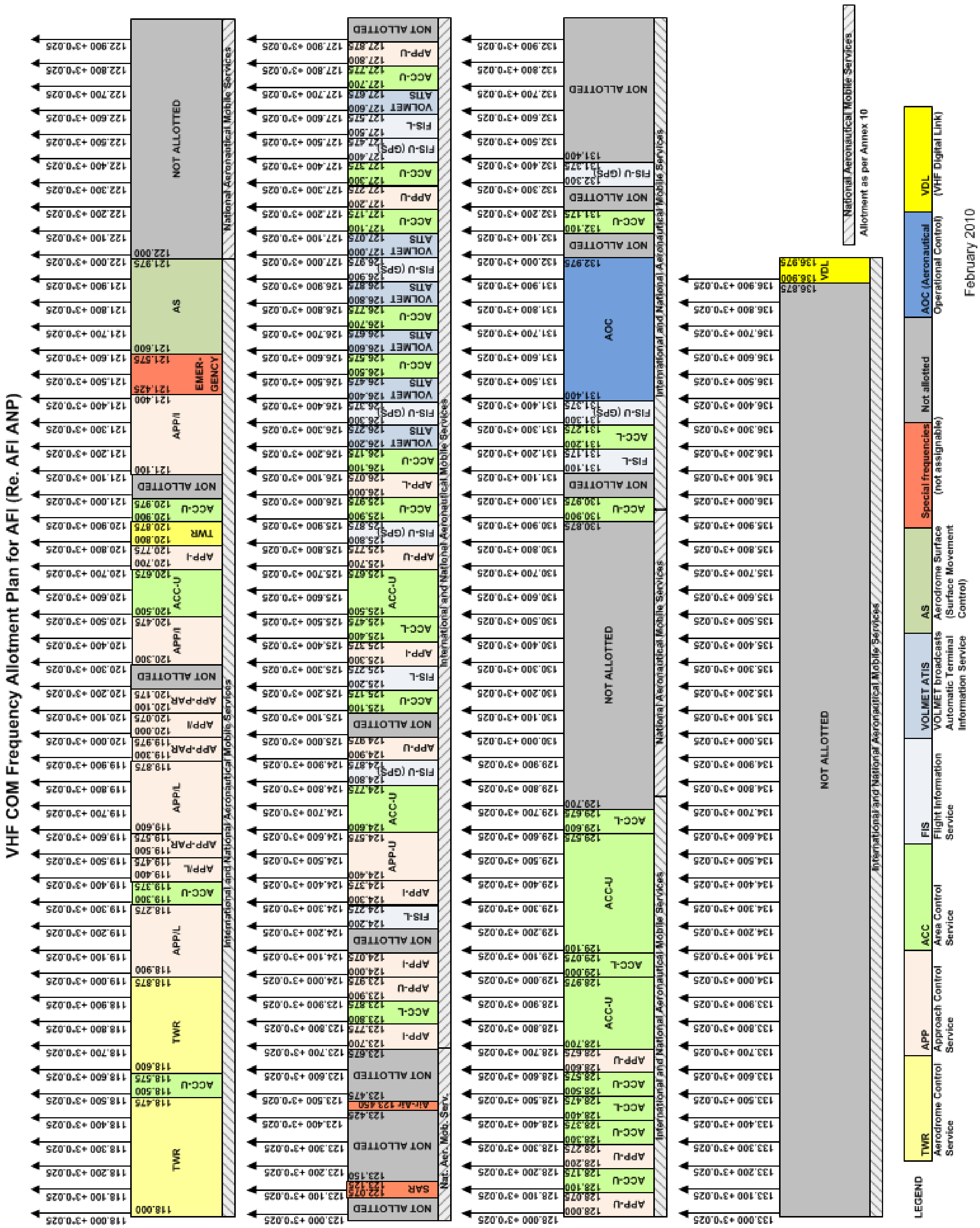
Table C-4

Minimum [legacy] geographical separation between interfering transmitter and victim receiver - Regional

		VICTIM											
	Service	TWR	AFIS	AS	APP-U	APP- I	APP-L	ACC-U	ACC-L	FIS-U	FIS- L	VOLMET	ATIS
INTERFERER	TWR	175	175	175	820	550	370	1000	750	1000	750	520	660
	AFIS	175	175	175	820	550	370	1000	750	1000	750	520	660
	AS *(Note 2)*	175	175	50	820	550	370	1000	750	1000	750	520	660
	APP-U	820	820	820	820	820	820	1000	820	1000	820	820	820
	APP-I	550	550	550	820	550	550	1000	750	1000	750	520	660
	APP-L	370	370	370	820	550	370	1000	750	1000	750	520	660
	ACC-U *(Note 1)*	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
	ACC-L *(Note 1)*	750	750	750	820	750	750	1000	750	1000	750	750	750

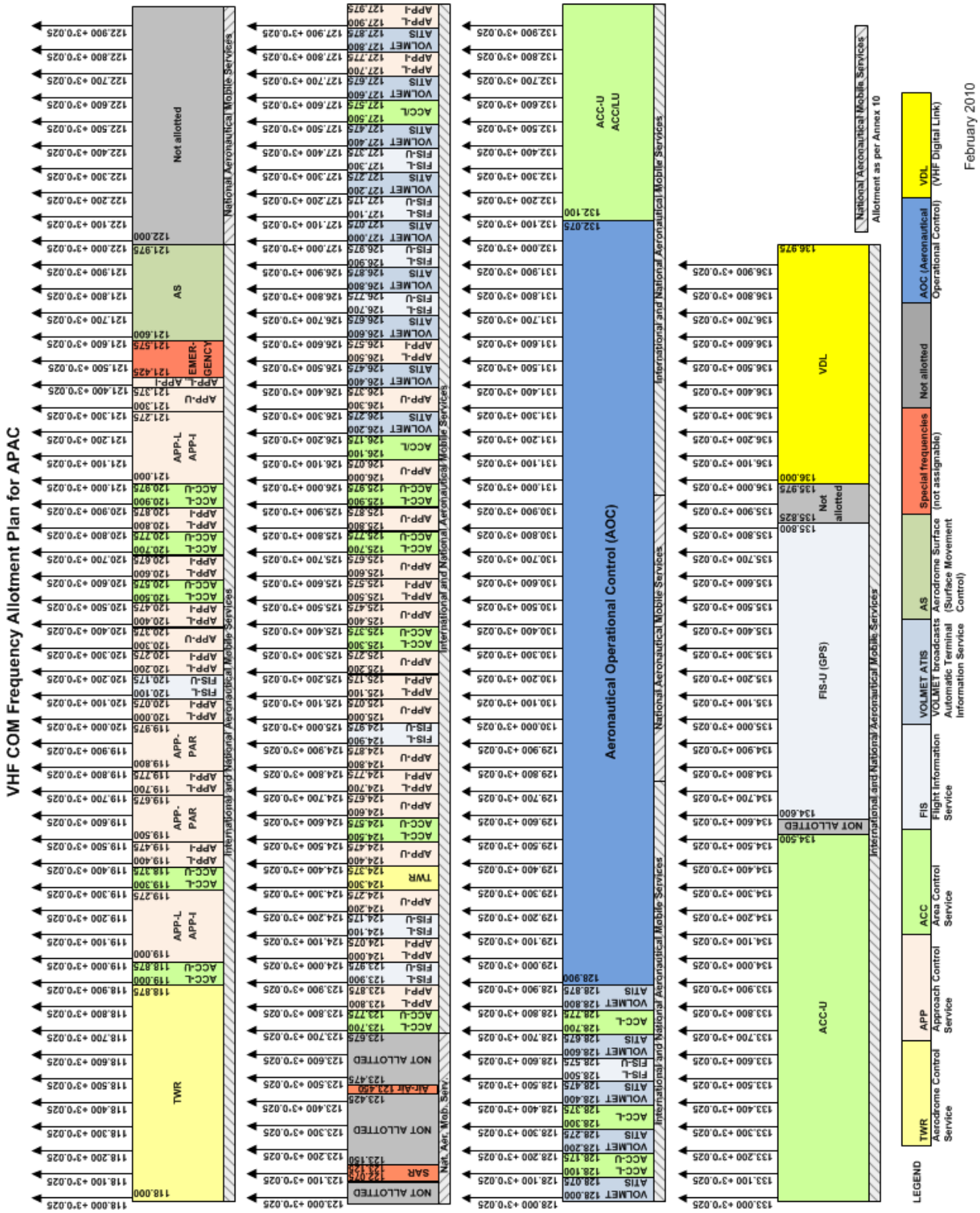
		VICTIM											
	Service	TWR	AFIS	AS	APP-U	APP- I	APP-L	ACC-U	ACC-L	FIS-U	FIS- L	VOLMET	ATIS
	FIS-U *(Note 1)*	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
	FIS-L *(Note 1)*	750	750	750	820	750	750	1000	750	1000	750	750	750
	VOLMET	520	520	520	820	520	550	1000	750	1000	750	520	660
	ATIS	660	660	660	820	660	660	1000	750	1000	750	660	660

Appendix D

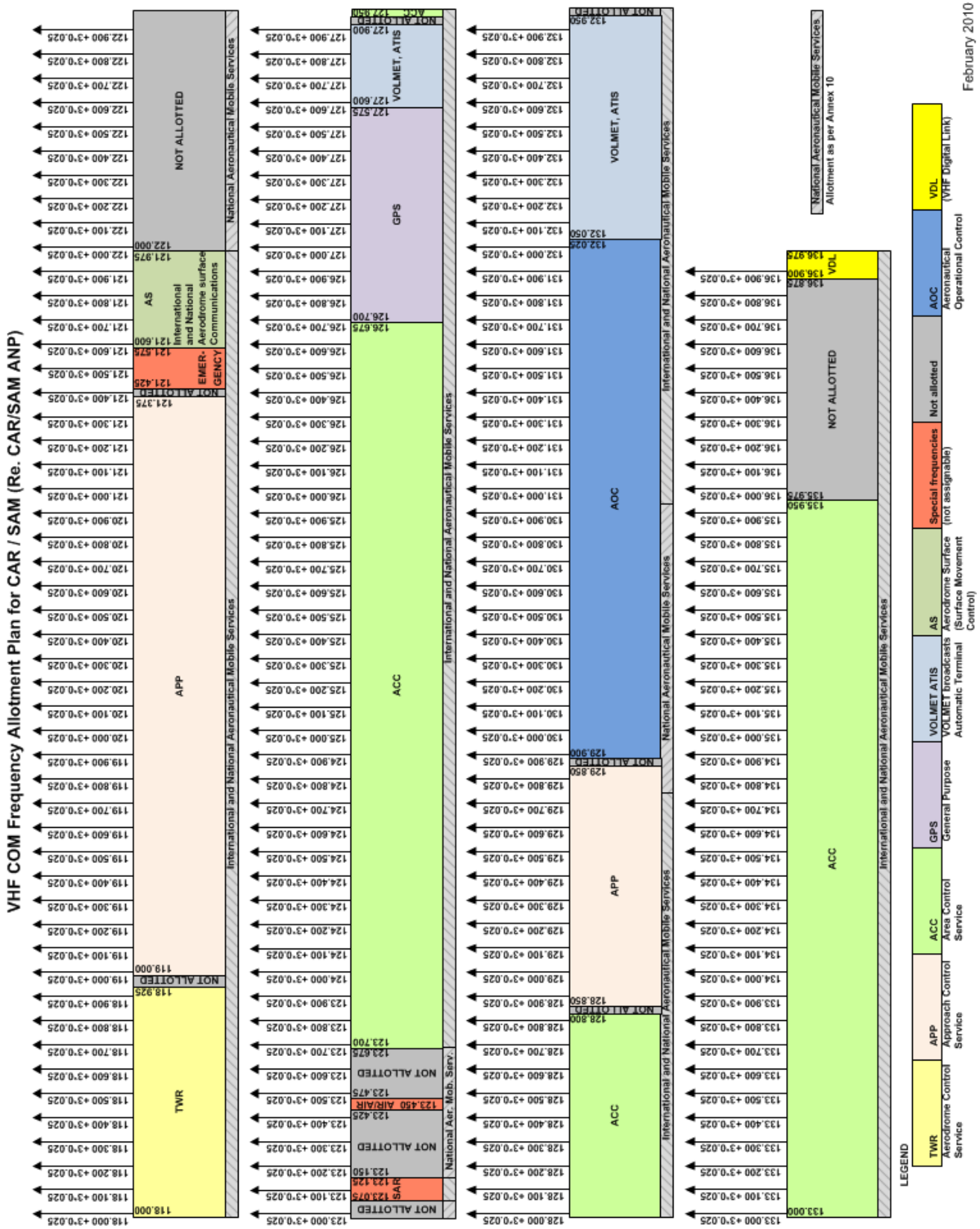


VHF COM Frequency Allotment Plan for AFI (Re. AFI ANP)
National Aeronautical Mobile Services
Allotment as per Annex 10
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service
ACC Area Control Service
FIS Flight Information Service
VOLMET ATIS VOLMET broadcasts Automatic Terminal Information Service
AS Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
Not allotted
AOC (Aeronautical Operational Control)
VDL (VHF Digital Link)
February 2010

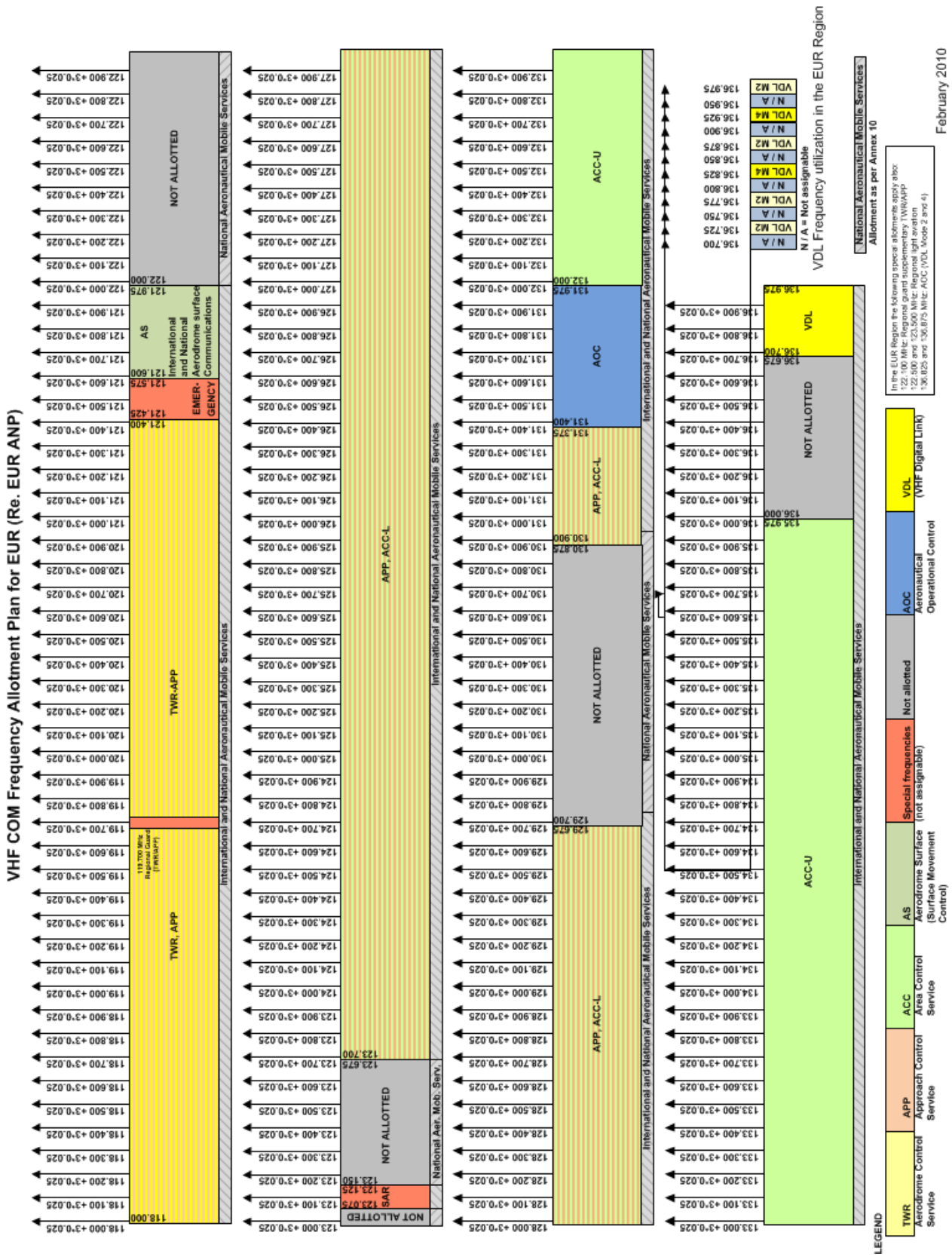
Appendix D


VHF COM Frequency Allotment Plan for APAC
February 2010
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service
ACC Area Control Service
FIS Flight Information Service
VOLMET ATIS VOLMET broadcasts Automatic Terminal Information Service
AS Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
Not allotted
AOC (Aeronautical Operational Control)
VDL (VHF Digital Link)
National Aeronautical Mobile Services
Allotment as per Annex 10
International and National Aeronautical Mobile Services
Aeronautical Operational Control (AOC)
ACC-U
ACC/LU
VDL
FIS-U (GPS)
NOT ALLOTTED
Not allotted
TWR
APP-L APP-I
APP-PAR
AS
EMER-GENCY
NOT ALLOTTED
SAR
TWR
Air-Air 123.450
NOT ALLOTTED
Nat. Aer. Mob. Serv.

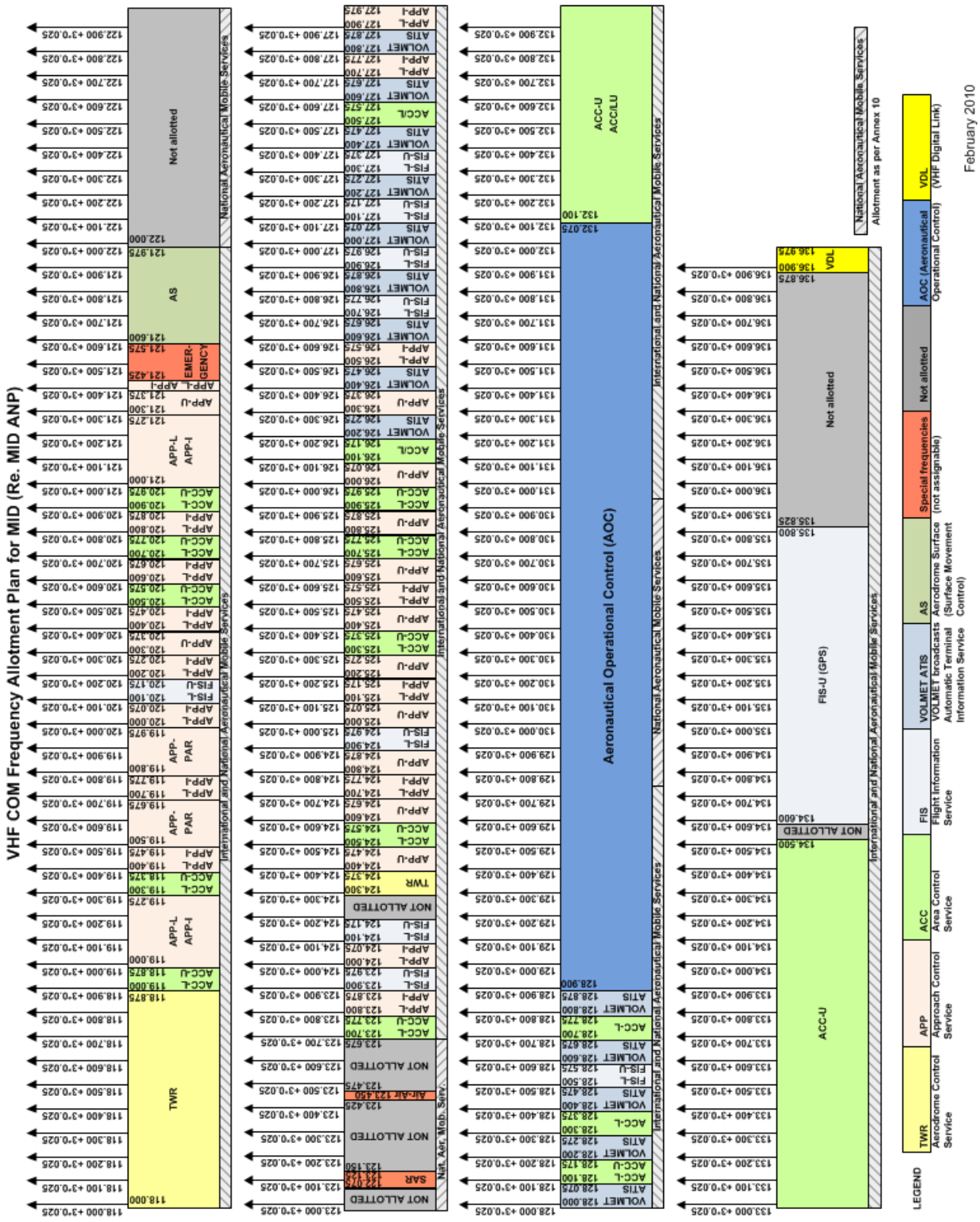
Appendix D


VHF COM Frequency Allotment Plan for CAR / SAM (Re. CAR/SAM ANP)
February 2010
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service
ACC Area Control Service
GPS General Purpose
VOLMET ATIS VOLMET broadcasts Automatic Terminal
AS Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
Not allotted
AOC Aeronautical Operational Control
VDL (VHF Digital Link)
National Aeronautical Mobile Services Allotment as per Annex 10
International and National Aeronautical Mobile Services
National Aeronautical Mobile Services
NOT ALLOTTED
TWR
APP
ACC
VOLMET, ATIS
AOC
GPS
VDL
AS
EMER-GENCY
International and National and Aerodrome surface Communications
SAR
123.450 AIR/AIR

Appendix D


VHF COM Frequency Allotment Plan for EUR (Re. EUR ANP)
VDL Frequency utilization in the EUR Region
February 2010
NOT ALLOTTED
TWR-APP
TWR, APP
APP, ACC-L
NOT ALLOTTED
SAR
ACC-U
AOC
APP, ACC-L
NOT ALLOTTED
ACC-U
VDL
NOT ALLOTTED
ACC-U
National Aeronautical Mobile Services
Allotment as per Annex 10
N / A = Not assignable
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service
ACC Area Control Service
AS Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
Not allotted
AOC Aeronautical Operational Control
VDL (VHF Digital Link)

Appendix D


VHF COM Frequency Allotment Plan for MID (Re. MID ANP)
February 2010
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service
ACC Area Control Service
FIS Flight Information Service
VOLMET broadcasts Automatic Terminal Information Service
AS Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
Not allotted
AOC (Aeronautical Operational Control)
VDL (VHF Digital Link)
National Aeronautical Mobile Services
Allotment as per Annex 10
International and National Aeronautical Mobile Services
Aeronautical Operational Control (AOC)
ACC-U
ACC/LU
FIS-U (GPS)
NOT ALLOTTED
Not allotted
VDL
136.900
136.875
135.825
135.800
134.600
134.500
TWR
APP-L
APP-I
APP-PAR
EMER-GENCY
AS
Not allotted
122.000
121.600
121.575
121.425
121.375
121.300
121.275
121.000
120.975
120.900
120.875
120.800
120.775
120.700
120.675
120.600
120.575
120.500
120.475
120.400
120.375
120.300
120.275
120.200
120.175
120.100
120.075
120.000
119.975
119.900
119.875
119.800
119.775
119.700
119.675
119.600
119.500
119.475
119.400
119.375
119.300
119.275
119.200
119.100
119.000
118.975
118.900
118.875
118.800
118.700
118.675
118.600
118.500
118.475
118.400
118.300
118.200
118.100
118.000
ACC-U
ACC-L
APP-U
APP-L
APP-I
FIS-U
FIS-L
APP-PAR
ATIS
VOLMET
TWR
NOT ALLOTTED
SAR
Air-Air 123.450
Nat. Aer. Mob. Serv.
ACC/L
ACC/U
132.900
132.075
132.100
132.000
131.900
131.800
131.700
131.600
131.500
131.400
131.300
131.200
131.100
131.000
130.900
130.800
130.700
130.600
130.500
130.400
130.300
130.200
130.100
130.000
129.900
129.800
129.700
129.600
129.500
129.400
129.300
129.200
129.100
129.000
128.900
128.875
128.800
128.775
128.700
128.675
128.600
128.575
128.500
128.475
128.400
128.375
128.300
128.275
128.200
128.175
128.100
128.075
128.000
127.975
127.900
127.875
127.800
127.775
127.700
127.675
127.600
127.575
127.500
127.475
127.400
127.375
127.300
127.275
127.200
127.175
127.100
127.075
127.000
126.975
126.900
126.875
126.800
126.775
126.700
126.675
126.600
126.575
126.500
126.475
126.400
126.375
126.300
126.275
126.200
126.175
126.100
126.075
126.000
125.975
125.900
125.875
125.800
125.775
125.700
125.675
125.600
125.575
125.500
125.475
125.400
125.375
125.300
125.275
125.200
125.175
125.100
125.075
125.000
124.975
124.900
124.875
124.800
124.775
124.700
124.675
124.600
124.575
124.500
124.475
124.400
124.375
124.300
123.675
123.600
123.500
123.475
123.425
123.300
123.200
123.150
123.075
123.000
122.900
122.800
122.700
122.600
122.500
122.400
122.300
122.200
122.100
122.000

APPENDIX E

Schematic overview of the functions in the module VHF air/ground communication systems

1. Appendix E contains a schematic overview of the various functions that are provided in the module VHF air/ground communication systems. This overview contains references to specific sections or paragraphs in the user manual for further details.

The overview provides a step-by-step guide to the functions included in Frequency Finder

The schematic overview is organized as follows:

Installing Frequency Finder
Start Page Frequency Finder
Home Page VHF air/ground communications
VHF COM data base page
Query
Manual selection or manual query
Find temporary (draft) frequencies
Preset Region
Export COM list
Mapping
Test frequency; summary calculations
Test frequency – detailed calculations
Test frequency – plotting interference
New or modified frequency assignment (
New or modified frequency assignment – new frequency assignment characteristics
New or modified frequency assignment – find new frequency assignment
New or modifies frequency assignment – modify existing frequency assignment
New or modified frequency assignment – Summary (of test results)

User Manual Chapter 2

Installing Frequency Finder

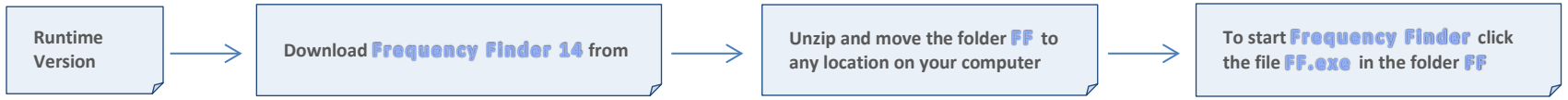
APPENDIX E

Full Version

User Manual: § 2.2

To start Frequency Finder click the file Frequency Finder <version>.fmp12

Runtime Version



User Manual: § 2.3

Google Earth

User Manual: § 2.4

Note: Administrative rights to install and / or use these programs may be required.

User Manual Chapter 3

Start Page Frequency Finder

First time or new version → **Frequency Finder** opens with START page. → New Version Alert when new version is used → Click OK to download from Frequency Finder essential files and folders

User Manual § 3.2 → Click button Copy documentation to your computer

Select from START page:

VHF COM selected (Page 3)

To go to the VHF COM data base

To go to the VHF NAV data base (in progress)

To go to the LF/MF NDB data base (to be added)

To go to the HF COM data base (to be added)

To go to the SSR Mode S data base (to be added)

VIEW ROUTES

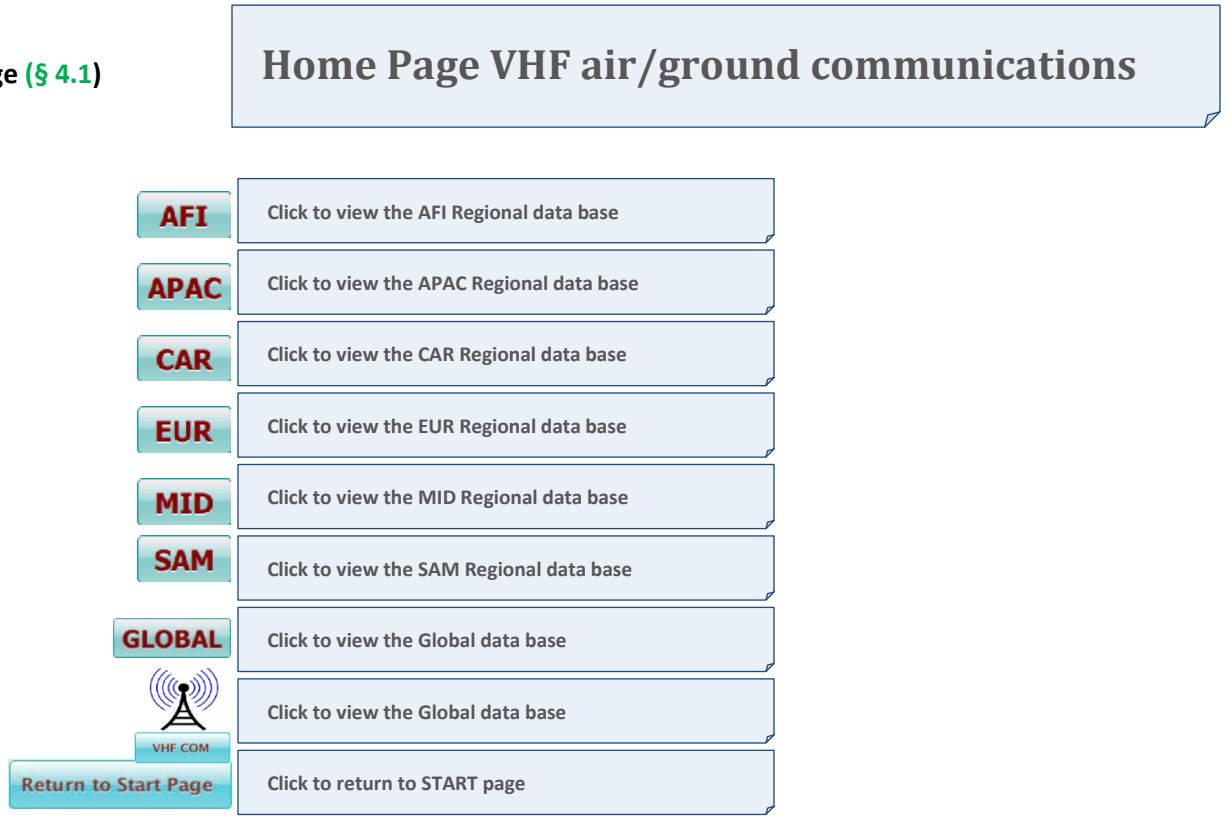
To go to the AIR ROUTES application

User Manual § 3.4

To find links to various relevant websites, documents and programs see User Manual, § 3.4.1 and 3.4.2

AIR ROUTES selected (Chapter 9)

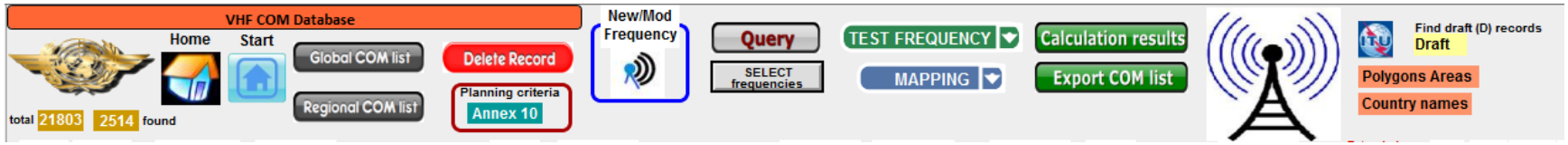
VHF COM Home page (§ 4.1)



User Manual § 4.2

VHF COM data base page

VHF COM data base tool bar:



The tool bar on the VHF COM data base page provides for the following navigation options and functions (re. :

Home

§.4.2.3.1

4.6.1111 Click to go to VHF COM Home Page § 4.2.3.1.b

§.4.2.3.1

Start

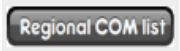
Click to go to START Page

§ 4.2.3.1.b

§.4.2.3.1

Click to view the Global data base

§.4.2.3.1



Click to view the Regional data base

§.4.2.3.1

Delete frequency (record) from data base

Click to select criteria from Annex 10 or Regional

§4.6.1.1

§ 4.7

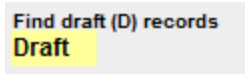
Click to enter new frequency or modify existing frequency

Click to start a QUERY

§ 4.3.2.1

Click to start / complete manual selection

§ 4.3.3



Find temporary (draft) frequencies (records)

§ 4.3.1

Click to start compatibility testing of frequencies

§ 4.6

Click to map (plot) coverage on map

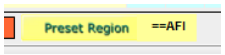
§ 4.5

Click to view the summary of calculation results

§ 4.2.3.1

Click to export data base or selection as COM list

§ 4.4



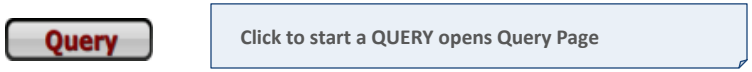
Click to preset the selection of a Region

§ 3.4.6

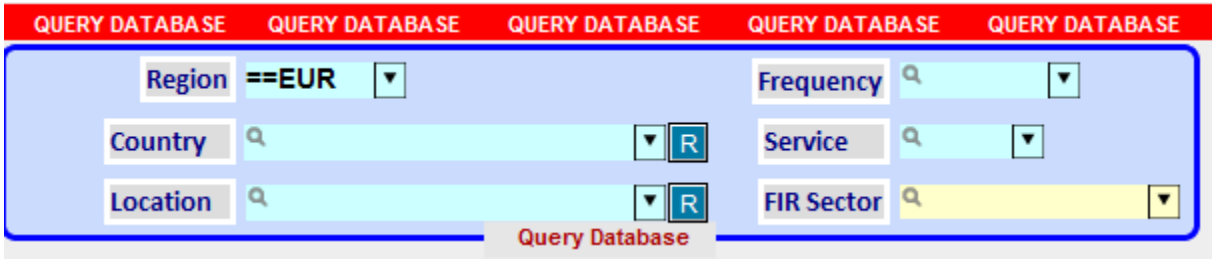
These buttons show pages for:
Generation of ITU Notices for registering frequency assignments with the IFL
To view the table with coordinates for area services
To view the table with Country names and addresses

Query

User Manual §4.3.2



§ 4.3.2.1 – Enter criteria for query from drop- down menu



Always select Region § 4.3.2.1

Optionally select Country and Location § 4.3.2.1 (To enter a location, first select a country)

Optionally select Frequency or Service or FIR Sector § 4.3.2.1 and § 4.3.2.5 (These parameters are mutually exclusive). Use the button "R" to change a selection

Click 

§ 4.3.2.2

To enter new query parameters click 

§ 4.3.2.3

To enter last saved query parameters click 

§ 4.2.3.4

To navigate to the Home Page or the VHF COM data base page click 

or 

respectively

User Manual § 4.3.3

Manual selection or manual query

To start manual selection click SELECT frequencies **on the VHF COM data base page § 4.3.3.**

When the button turns into SELECT frequencies **click on each frequency you want to select**

The background color of each selected frequency changes into dark green:

29019	AFI		124.100	Democratic Republic of the Congo	DRC	MBANDAKA	00D02'00"	N	018D17'00"	E	ACC-U

SELECT frequencies **to complete the manual selection of frequency assignments**

User Manual § 4.3.1

Find temporary (draft) frequencies

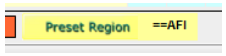
Draft (D) frequency assignments are kept in the data base pending coordination by the Regional Office.

To find all draft frequency assignment click on the VHF COM data base p Find temporary (D) records D **§ 4.3.1**

User Manual §4.2.3.1.a

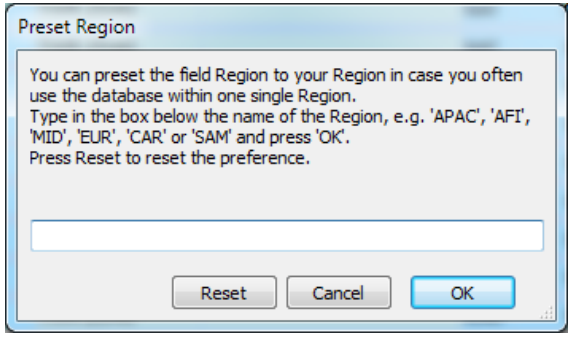
Preset Region

Preset Region in case Frequency Finder is mostly used only within one singe Region

To preset a Region click 

on the VHF COM data base page (bottom bar)

In the pop-up box



type the Region name and click OK

When using 

the program returns the regional VHF COM list for the preset Region

The function "Preset Region" is accessible from various pages of Frequency Finder

Export COM list

User Manual § 4.4

Export COM list **to view the selection of frequencies VHF COM list in *ICAO COM list* format.** § 4.4.1

Note: The selection can be as a result of a query or the complete Regional COM list.

Click one of the buttons Sort: Cty/Loc/Freq Sort: Freq/Cty/Loc Sort: Loc/Freq **to select the sort order**

For exporting the COM list, see user Manual §

Export FMP **to export in FileMaker Pro format. The file is saved in the folder ICAOfrequencydownload/SaveFMP**

Export Excel **to export in Excel format. The file is saved in the folder ICAOfrequencydownload/SaveExcel**

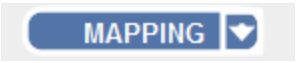
Export PDF **to export in Adobe pdf format. The file is saved in the folder ICAOfrequencydownload/SavePDF**
(Export is pdf format is only possible when using the full version)

Print **to print the COM list. Set the printer to orientation "landscape"** § 4.4.4

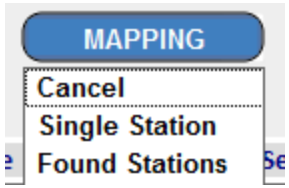
Folder ICAOfrequencydownload **Click button "Folder ICAOfrequencydownload" to view folders where exported files are saved.**

User Manual § 4.5

Mapping



Click the button "Mapping" to plot the coverage of the frequency assignment on the map (Google Earth) § 4.5



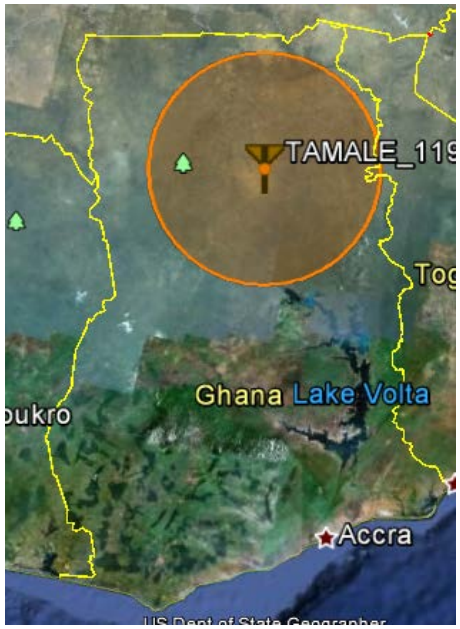
Select from drop-down menu to plot on the map the coverage of a single station or of all the stations of a selection (e.g. as a result of a query or a manual selection.

After the selection, the mapping procedure will start and the coverage of the station (or the selected stations) is plotted on the map.

TAMALE_119.100MHz

TAMALE [GHANA]

119.100 MHz
Location =TAMALE
Service =APP-I
Range = 75 NM
Height = 25000 Feet
Radio Horizon = 194 NM
Latitude= 09D34'00'' N
Longitude= 000D52'00'' W
Category = NAT
Condition = OP
Remarks:
FIR name =
Extended Range =
Key # **41418**



When plotting the coverage with the button 

the coverage is shown with a orange circle or polygon (for FIR).
The icon, is at the coordinates of the station.

When clicking the icon on the map, a balloon with details pertinent to the frequency assignment will be shown.

Note: when clicking "Selected stations" from the drop down menu, all stations of the selection or query will be plotted on the map. § 4.5.3

See the User Manual for further examples of plotting the coverage, in particular for area services.

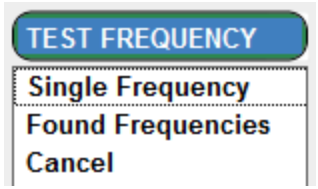
User Manual § 4.6, § 4.6.1 and § 4.6.4

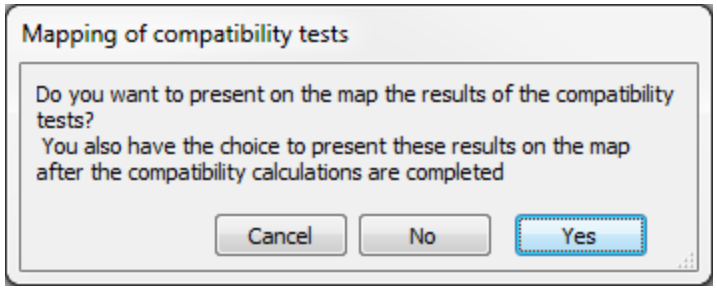
Test Frequency; summary calculations

Select from the VHF COM data base window 

to test with planning criteria as per Annex 10 § 4.6.1.1

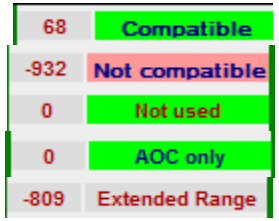
Click button "TEST FREQUENCY" and select from drop-down menu to test a single frequency or a selection of frequencies § 4.6.1.2





When Test Single Frequency is selected, the calculation results, including the interference contours (if any) can be plotted on the map through the pop-up dialog box § 4.6.2.1

After test calculations are completed the window Summary Calculations provides a summary of the test results. This window contains certain details of the test frequency and an indication whether or not this frequency assignment is compatible with other frequency assignments in the plan as follows: § 4.6.2.1.1



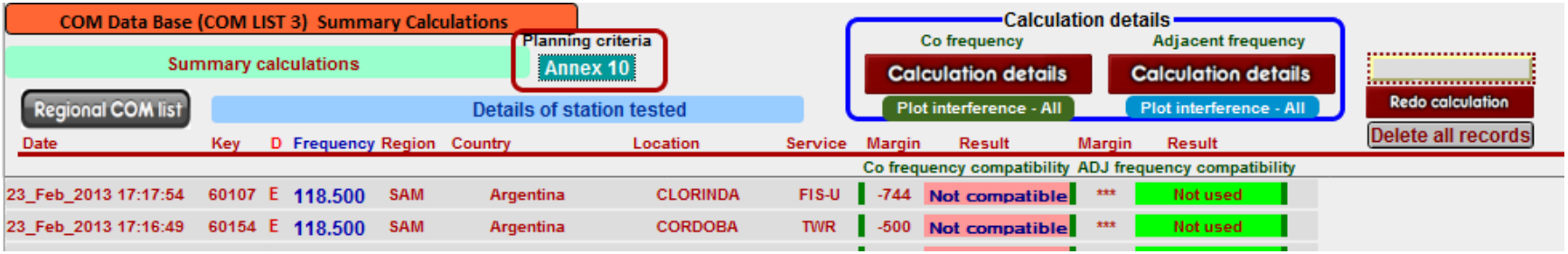
the frequency is compatible
the frequency is not compatible
the frequency is not used (and compatible)
the frequency is only used for AOC (and compatible
the frequency is part of an extended range network and compatible

Note the figures above show the margin to the nearest station; if the margin is ≥0, the frequency is compatible; if the margin is <0, the frequency is not compatible

User Manual §4.6.4

Test Frequency; summary calculations (ctd)

Summary calculations tool bar: § 4.6.4



Co frequency

Calculation details

Adjacent frequency

Calculation details

Click the button "calculation details" to view the detailed test results for either the co-frequency or the adjacent frequency compatibility.

These details include a listing of all stations that were tested and do not meet the frequency protection criteria, including the distance margin for each of these stations.

Only the most recent test results are saved and can be viewed with these buttons. To view detailed test results of earlier calculations, re-do the test with the button Redo calculation **.** § 4.6.5

Click one of the buttons "Plot interference" to plot interference contours OF THE MOST RECENT (current) calculation results on the map. § 4.6.5

Delete all records **Click "Delete all records" to empty the list. This should be done regularly to remove old and irrelevant test results.** § 4.6.5.4

Redo calculation **Click the button "Redo calculation" to re-start the testing of earlier calculations The new test results are saved at the top of the list. The compatibility test can be re-started with the choice of Annex 10 or Regional frequency assignment planning criteria by clicking the button** Planning criteria Annex 10 **on the tool bar.** § 4.6.5.2

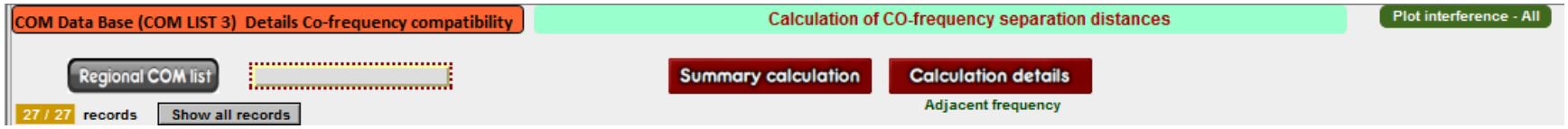
NEW/MOD Frequency **Click the button NEW/MOD frequency to navigate quickly to the window NEW/MOD Frequency. This button can only be used when for draft (D) frequencies. These are identified in the window summary calculations with the suffix D to the Key number.**

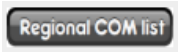
User Manual § 4.6.5 and § 4.6.6

Test Frequency; detailed calculations
co-frequency and adjacent frequency

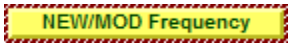
The windows co-frequency compatibility and adjacent frequency compatibility present details on the co- and adjacent frequency test results

The toolbar of the window co-frequency compatibility shows (§ 4.6.6)





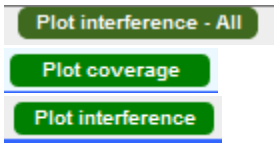
to navigate to the Regional COM list in the VHF COM data base



to navigate quickly to the window NEW/MOD frequency (only for draft records)

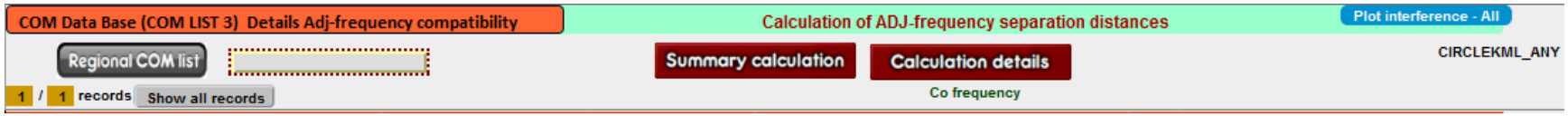
to navigate to the window Summary calculation

to navigate to the table with adjacent frequency test results



These buttons can be used to plot interference calculations on the map for all calculation results or for each single calculation result. The button "coverage" plots the coverage of the station being tested.

The toolbar of the window adjacent frequency compatibility shows (§ 4.6.7)

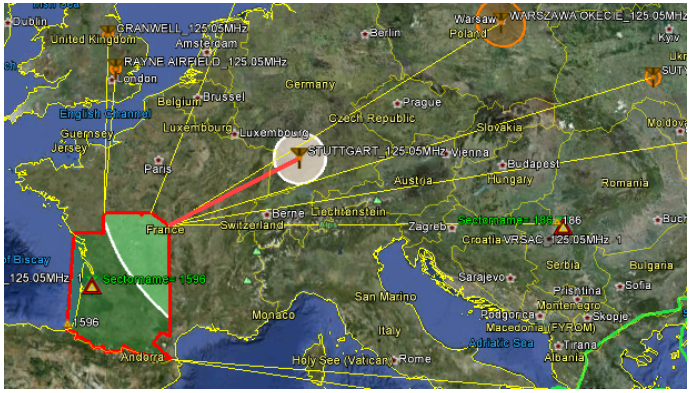


The functions of the various buttons on this window are similar to those on the window "co-frequency compatibility".

Test Frequency; plotting interference
co-frequency (examples)

Interference contours are printed on the map with a white outline (circle segment, circle or polygon).

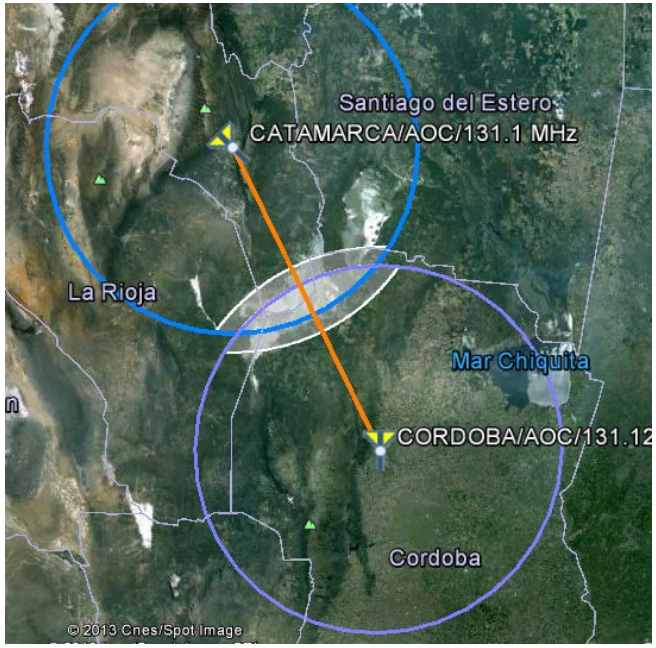
Co-frequency interference between Tamale and Bamako-Senou in the AFI Region; both coverage areas are partially being interfered by each other (white circle segment)



Co-frequency interference between Bordeaux-ACC (area service) and Stuttgart APP; the interfered stations are connected with a red line; station that do not interfere with each other are connected with a thin yellow line.

Test Frequency; plotting interference

Adjacent frequency (examples)



Adjacent frequency interference shows as a circle-se3gment with a buffer zone of 10 NM outside the coverage of the interferer.

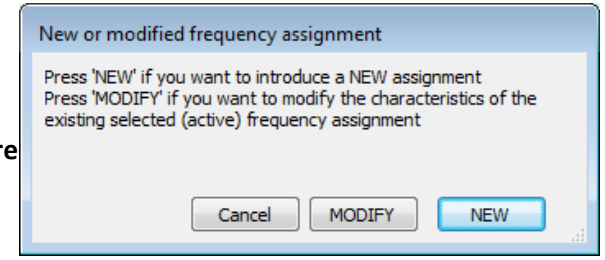
New or Modified frequency assignment

User Manual § 4.7

To start introducing a new frequency assignment or to modify an existing frequency assignment click 

on the toolbar of the VHF COM data base window § 4.7.1.2

From the pop-up dialog box click NEW to enter new assignment or MOD to modify an existing assignment – Click NEW § 4.7.1.3



On the window NEW / MOD frequency in the tool bar:

New assignment indicates a new frequency assignment is considered

Mod assignment indicates a modification to a frequency assignment is considere

On the tool bar with 

the new or modified frequency can be tested with criteria as per Annex 10 or as Regionally agreed . Click this button to change the planning criteria

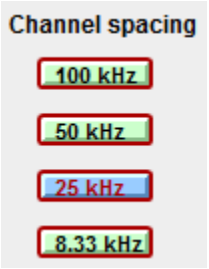
The window NEW/ MOD frequency opens. This window has three panes: § 4.7.3

- Station § 4.7.3.1
- Find Frequency § 4.7.7
- Summary § 4.7.5

The field Extended Range indicates if the frequency is part of an extended range facility

The field Preset Region indicates if a Region has been preset.

The data in these fields is just provided for information § 4.7.2.1



With the buttons “Channel spacing” the user can select to search for frequencies in multiples of 25 kHz, 50 kHz or

In all cases however, compatibility is being calculated using frequency assignment planning criteria for 25 kHz.

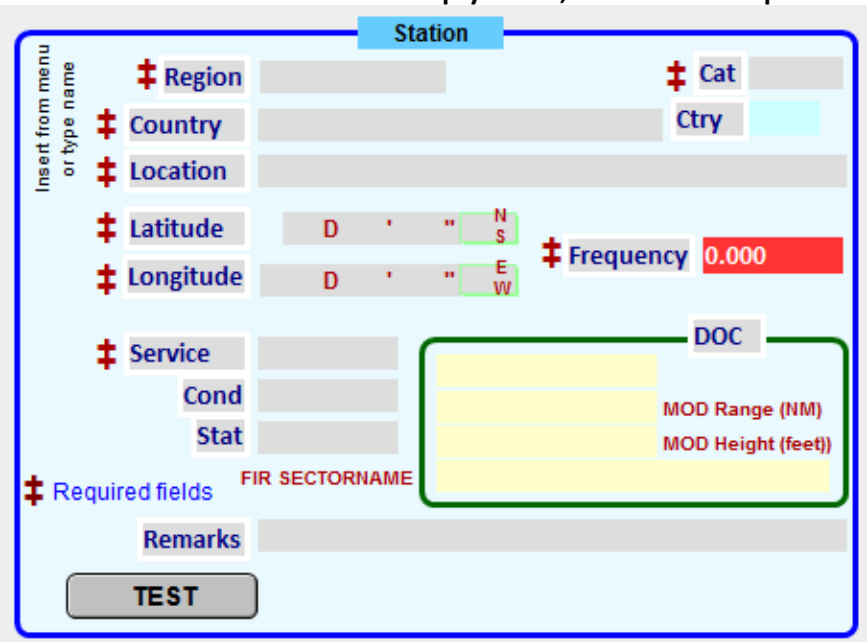
Prior to searching for frequencies, a selection should be made. The default is 25 kHz § 4.7.7.1.1

User Manual §4.7

New or Modified frequency assignment
new frequency assignment characteristics

Pane Station

Enter the station characteristics in the empty boxes; use as much as possible the drop-down menus that are provided. § 4.7.3.1



Note: entering the Service, will enter the DOC in the green box the uniform value for the "DOC". Non-uniform values can be entered in the fields MOD Range and Mod Height *§4.7.3.1.2*

been **Enter ONLY a frequency if a frequency has already**

empt **determined; in other cases leave the field Frequency**

If a (pre-determined) frequency has been entered, click the button TEST **This button turns red when a frequency is entered in the box Frequency** § 4.7.4

uency, turn to the pane Find Frequency § 4.7.7

The test results obtained with the button TEST **are identified:**

The selected frequency is compatible.

The selected frequency is NOT compatible.

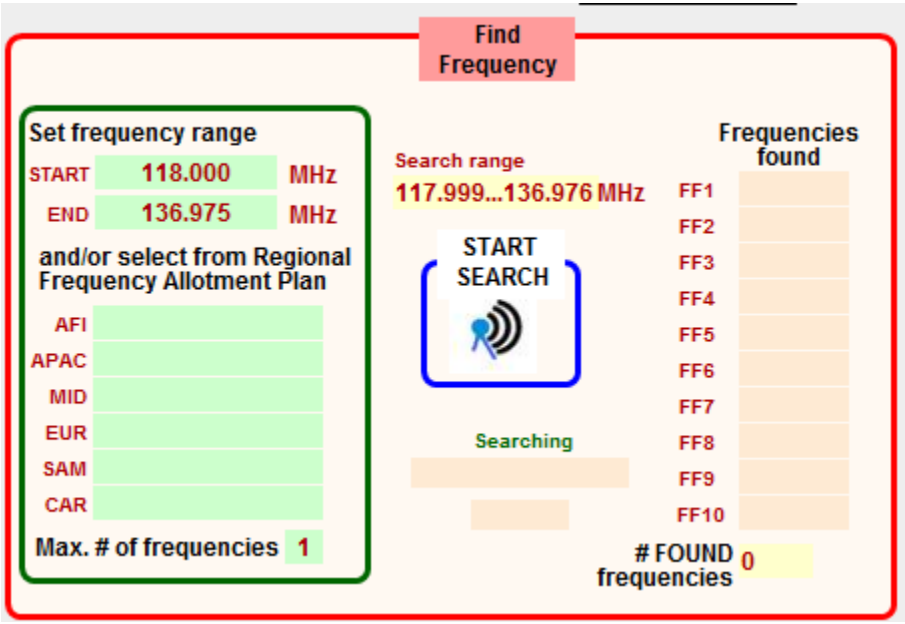
For the linking of a frequency assignment with an area service (e.g. FIR) see manual §4.7.3.2

User manual § 4.7 and § 4.7.7

New or Modified frequency assignment

find new frequency assignment

Pane Find Frequency



1a. Enter frequency range for the new frequency § 4.7.7.1.2.a

OR (preferred method)

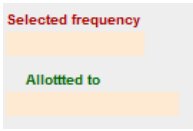
1b. select from the relevant Region the service from the Regional Frequency Allotment Plan § 4.7.7.1.2.b

2. Select Max. # of frequencies to search § 4.7.7.1.3

3. Click 

Frequency Finder starts searching for compatible frequencies § 4.7.7.1.4

After the search is completed, compatible frequencies (if any) are listed in column "Frequencies Found". § 4.7.7.2

4. Select a frequency; the selected frequency and allotment will be entered into the fields: 

§ 4.7.7.2.1

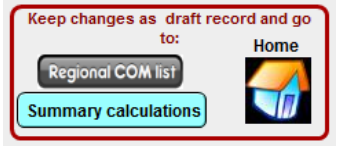
After this procedure has been completed, the selected frequency is also shown in the Pane "Station"

5. From the toolbar, the user can complete the search and test for a new frequency assignment by clicking the button 

or reject or cancel the changes with the button 

§ 4.7.8

6. In case the new frequency should remain in the VHF COM data base as a temporary or draft frequency, click a button in the field

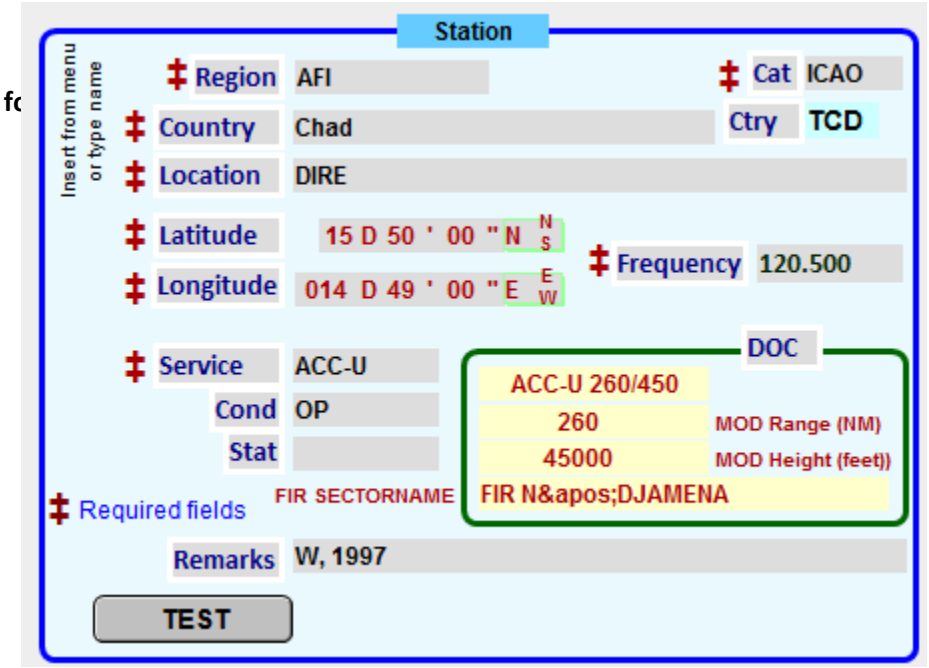


User Manual § 4.7

New or Modified frequency assignment

modify existing frequency assignment

When, on the VHF COM data base page in pop-up dialog box for NEW/MOD Frequency "MOD" has been clicked, the window NEW/MOD frequency opens similar as described for adding a new frequency assignment but the data for the existing frequency assignment is added in the fields in the Pane "Station". § 4.7.3.1



See also the description for entering the characteristics for a new frequency assignment above

As described for a new frequency assignment the user can modify the data in this pane, as required.
Note: this is the only method to modify the data for an existing frequency assignment.

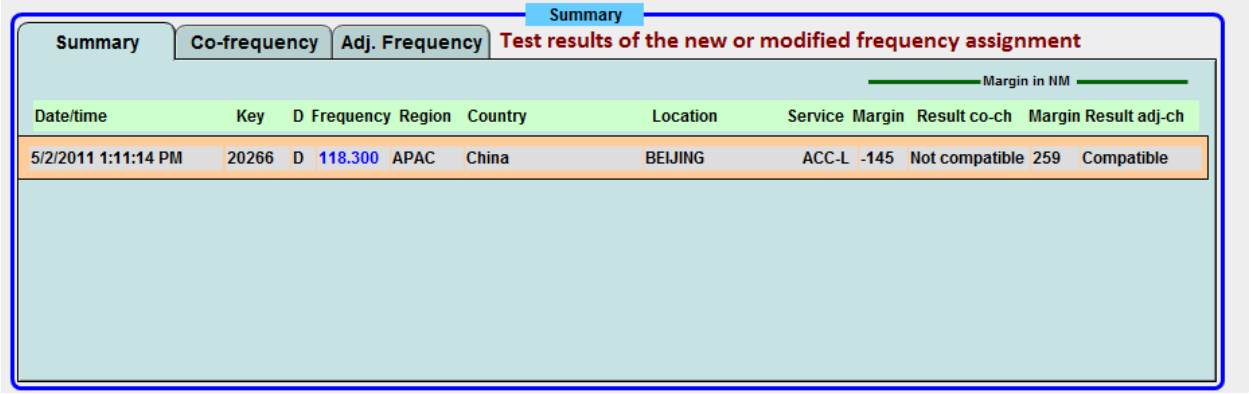
A new frequency can be entered in the field Frequency or a search for a new frequency can be initiated in the Pane Find Frequency.

Note: the methodology is the same as described above for a new frequency

User manual 4.7.5

New or Modified frequency assignment
Summary (applies to new and existing frequency assignment)

Pane Summary



The pane Summary shows the most essential characteristic of the test results.

With the tab Summary, a summary of the test results, similar to the window "Summary Calculation" is presented. § 4.7.5.1.1

The tab Co-frequency shows details of all frequency assignment that can cause co-frequency interference § 4.7.5.1.2

The tab Adj. Frequency shows details of all frequency assignment that can cause adjacent frequency interference § 4.7.5.1.3

Note: In case no interfering stations have been identified, the tabs co-frequency and adj. frequency are empty and contain only the name of the station under test.

Appendix F

Generation of 12/T13 Notices.

To include: coordinates for FIR sectors and update program for T12 notices.

Appendix G

Flight Information Regions.

99100	FIR aaa_0	FIR aaa_0 / NA / NN
99101	FIR aaa_1	FIR aaa_1 / NA / NN
99102	FIR ACCRA	FIR ACCRA / DGAC / GHA
99103	FIR ADDIS ABABA	FIR ADDIS ABABA / HAAA / ETH
99104	FIR AKTAU	FIR AKTAU / UATE / XXXK
99105	FIR AKTYUBINSK	FIR AKTYUBINSK / UATT / XXXK
99106	FIR ALBUQUERQUE	FIR ALBUQUERQUE / KZAB / USA
99107	FIR ALGER_L	FIR ALGER_L / DAAA / ALG
99108	FIR ALGER_U	FIR ALGER_U / DAAA / ALG
99109	FIR ALMATY	FIR ALMATY / UAAA / XXXK
99110	FIR AMAZONICA	FIR AMAZONICA / SBAZ / B
99111	FIR AMMAN	FIR AMMAN / OJAC / JOR
99112	FIR AMSTERDAM	FIR AMSTERDAM / EHAA / HOL
99113	FIR ANCHORAGE ARCTIC	FIR ANCHORAGE ARCTIC / PZAN / USA
99114	FIR ANCHORAGE CONTINENTAL EAST	FIR ANCHORAGE CONTINENTAL EAST / PAZA / USA
99115	FIR ANCHORAGE CONTINENTAL WEST	FIR ANCHORAGE CONTINENTAL WEST / PAZA / USA
99116	FIR ANCHORAGE OCEANIC EAST	FIR ANCHORAGE OCEANIC EAST / PZAN / USA
99117	FIR ANCHORAGE OCEANIC WEST	FIR ANCHORAGE OCEANIC WEST / PZAN / USA
99118	FIR ANKARA	FIR ANKARA / LTAA / TUR
99119	FIR ANTANANARIVO	FIR ANTANANARIVO / FMMM / MDG
99120	FIR ANTOFAGASTA	FIR ANTOFAGASTA / SCFZ / CHL
99121	FIR ASHGABAT	FIR ASHGABAT / UTAA / XTT
99122	FIR ASMARA	FIR ASMARA / HHAA / ERI
99123	FIR ASTANA	FIR ASTANA / UACC / XXXK
99124	FIR ASUNCION	FIR ASUNCION / SGFA / PRG
99125	FIR ATHINAI	FIR ATHINAI / LGGG / GRC
99126	FIR ATLANTA	FIR ATLANTA / KZTL / USA
99127	FIR ATLANTICO	FIR ATLANTICO / SBAO / B
99128	FIR AUCKLAND OCEANIC EAST	FIR AUCKLAND OCEANIC EAST / NZZO / NZL
99129	FIR AUCKLAND OCEANIC WEST	FIR AUCKLAND OCEANIC WEST / NZZO / NZL
99130	FIR BAGHDAD	FIR BAGHDAD / ORBB / IRQ
99131	FIR BAHRAIN	FIR BAHRAIN / OKAC / BHR
99132	FIR BAKU	FIR BAKU / UBBB / AZE
99133	FIR BANGKOK	FIR BANGKOK / VTBB / THA
99134	FIR BARCELONA	FIR BARCELONA / LEBL / E
99135	FIR BARRANQUILLA	FIR BARRANQUILLA / SKEC / CLM
99136	FIR BEIJING	FIR BEIJING / ZBPE / CHN
99137	FIR BEIRA_L	FIR BEIRA_L / FQBE / MOZ
99138	FIR BEIRA_U	FIR BEIRA_U / FQBE / MOZ
99139	FIR BEIRUT	FIR BEIRUT / OLBA / LBN
99140	FIR BEOGRAD	FIR BEOGRAD / LYBA / SCG
99141	FIR BISHKEK	FIR BISHKEK / UAFM / XKK
99142	FIR BODO OCEANIC	FIR BODO OCEANIC / ENOB / NOR

99143	FIR BOGOTA	FIR BOGOTA / SKED / CLM
99144	FIR BORDEAUX	FIR BORDEAUX / LFBB / F
99145	FIR BOSTON	FIR BOSTON / KZBW / USA
99146	FIR BRASILIA	FIR BRASILIA / SBBS / B
99147	FIR BRATISLAVA	FIR BRATISLAVA / LZBB / SVK
99148	FIR BRAZZAVILLE	FIR BRAZZAVILLE / FCCC / ASE
99149	FIR BREMEN	FIR BREMEN / EDWW / D
99150	FIR BREST	FIR BREST / LFRR / I
99151	FIR BRINDISI	FIR BRINDISI / LIBB / I
99152	FIR BRISBANE	FIR BRISBANE / YBBB / AUS
99153	FIR BRUXELLES	FIR BRUXELLES / EBBU / BEL
99154	FIR BUCURESTI	FIR BUCURESTI / LRBB / ROU
99155	FIR BUDAPEST	FIR BUDAPEST / LHCC / HNG
99156	FIR BUJUMBURA_L	FIR BUJUMBURA_L / HBBA / BDI
99157	FIR CAIRO	FIR CAIRO / HECC / EGY
99158	FIR CANARIAS_L	FIR CANARIAS_L / GCCC / E
99159	FIR CANARIAS_U	FIR CANARIAS_U / GCCC / E
99160	FIR CAPETOWN	FIR CAPETOWN / FACT / RSA
99161	FIR CASABLANCA	FIR CASABLANCA / GMMM / MRC
99162	FIR CENTRAL AMERICAN	FIR CENTRAL AMERICAN / MHTG /
99163	FIR CHENNAI	FIR CHENNAI / VOMF / IND
99164	FIR CHICAGO	FIR CHICAGO / KZAU / USA
99165	FIR CHISINAU	FIR CHISINAU / LUKK / MDA
99166	FIR CLEVELAND	FIR CLEVELAND / KZOB / USA
99167	FIR COLOMBO	FIR COLOMBO / VCCC / SLK
99168	FIR COMODORO RIVADAVIA	FIR COMODORO RIVADAVIA / SAVF / ARG
99169	FIR CORDOBA	FIR CORDOBA / SACF / ARG
99170	FIR CURACAO	FIR CURACAO / TNCF / ATN
99171	FIR CURITIBA	FIR CURITIBA / SBCW / B
99172	FIR DAKAR OCEANIC_L	FIR DAKAR OCEANIC_L / GOOO / ASE
99173	FIR DAKAR_L	FIR DAKAR_L / GOOO / ASE
99174	FIR DAKAR_U	FIR DAKAR_U / GOOO / ASE
99175	FIR DAMASCUS	FIR DAMASCUS / OSDI / SYR
99176	FIR DAR ES SALAAM_L	FIR DAR ES SALAAM_L / HTDC / TZN
99177	FIR DAR ES SALAAM_U	FIR DAR ES SALAAM_U / HTDC / TZN
99178	FIR DASHOGUZ	FIR DASHOGUZ / UTAT / XTT
99179	FIR DELHI	FIR DELHI / VIDF / IND
99180	FIR DENVER	FIR DENVER / KZDV / USA
99181	FIR DHAKA	FIR DHAKA / VGFR / BGD
99182	FIR DUSHANBE	FIR DUSHANBE / UTDD / XXT
99183	FIR EASTER I.	FIR EASTER I. / SCIZ / CHL
99184	FIR EDMONTON	FIR EDMONTON / CZEG / CAN
99185	FIR EMIRATES	FIR EMIRATES / OMAE / UAE
99186	FIR ENTEBBE	FIR ENTEBBE / HUEC / UGA
99187	FIR EZEIZA	FIR EZEIZA / SAEF / ARG
99188	FIR FINLAND	FIR FINLAND / EFIN / FIN
99189	FIR FT WORTH	FIR FT WORTH / KZFW / USA
99190	FIR FUKUOKA	FIR FUKUOKA / RJJJ / J
99191	FIR GABORONE_L	FIR GABORONE_L / FBGR / BOT
99192	FIR GABORONE_U	FIR GABORONE_U / FBGR / BOT

99193	FIR GANDER DOMESTIC	FIR GANDER DOMESTIC / CZQX / CAN
99194	FIR GANDER OCEANIC_L	FIR GANDER OCEANIC_L / CZQX / CAN
99195	FIR GANDER OCEANIC_U	FIR GANDER OCEANIC_U / CZQX / CAN
99196	FIR GEORGETOWN	FIR GEORGETOWN / SYGC / GUY
99197	FIR GUANGZHOU	FIR GUANGZHOU / ZGZU / CHN
99198	FIR GUAYAQUIL	FIR GUAYAQUIL / SEGU / EQA
99199	FIR HABANA	FIR HABANA / MUFH / CUB
99200	FIR HANOI	FIR HANOI / VVVV / VTN
99201	FIR HARARE	FIR HARARE / FVHF / ZWE
99202	FIR HO-CHI-MINH	FIR HO-CHI-MINH / VVTS / VTN
99203	FIR HONG KONG	FIR HONG KONG / VHHK / HKG
99204	FIR HONIARA	FIR HONIARA / HGGG / SLM
99205	FIR HOUSTON	FIR HOUSTON / KZHU / USA
99206	FIR HOUSTON OCEANIC	FIR HOUSTON OCEANIC / KZHU / USA
99207	FIR INCHEON	FIR INCHEON / RKRR / KOR
99208	FIR INDIANAPOLIS	FIR INDIANAPOLIS / KZID / USA
99209	FIR IRKUTSK	FIR IRKUTSK / UIII / RUS
99210	FIR ISTANBUL	FIR ISTANBUL / LTBB / TUR
99211	FIR JACKSONVILLE	FIR JACKSONVILLE / KZJX / USA
99212	FIR JAKARTA	FIR JAKARTA / WIIZ / INS
99213	FIR JEDDAH	FIR JEDDAH / OEJD / ARS
99214	FIR JOHANNESBURG	FIR JOHANNESBURG / FAJS / RSA
99215	FIR JOHANNESBURG OCEANIC	FIR JOHANNESBURG OCEANIC / FAJO / RSA
99216	FIR KABUL	FIR KABUL / OAKX / AFG
99217	FIR KALININGRAD	FIR KALININGRAD / UMKK / RUS
99218	FIR KANO	FIR KANO / DNKK / NIG
99219	FIR KANSAS CITY	FIR KANSAS CITY / KZKC / USA
99220	FIR KARACHI	FIR KARACHI / OPKR / PAK
99221	FIR KATHMANDU	FIR KATHMANDU / VNSM / NPL
99222	FIR KHABAROVSK	FIR KHABAROVSK / UHHH / RUS
99223	FIR KHARKIV	FIR KHARKIV / UKHV / UKR
99224	FIR KHARTOUM	FIR KHARTOUM / HSSS / SDN
99225	FIR KIGALI	FIR KIGALI / HRYR / RRW
99226	FIR KINGSTON	FIR KINGSTON / MKJK / JMC
99227	FIR KINSHASA_L	FIR KINSHASA_L / FZZA / DRC
99228	FIR KINSHASA_U	FIR KINSHASA_U / FZZA / DRC
99229	FIR KOBENHAVN	FIR KOBENHAVN / EKDK / DNK
99230	FIR KOLKATA	FIR KOLKATA / VECF / IND
99231	FIR KOTA KINABALU	FIR KOTA KINABALU / WBFC / MLA
99232	FIR KRASNOYARSK	FIR KRASNOYARSK / UNKL / RUS
99233	FIR KUALA LUMPUR	FIR KUALA LUMPUR / WMFC / MLA
99234	FIR KUNMING	FIR KUNMING / ZPKM / CHN
99235	FIR KUWAIT	FIR KUWAIT / OKAC / KWT
99236	FIR KYIV	FIR KYIV / UKBV / UKR
99237	FIR KYZYLORDA	FIR KYZYLORDA / UAOO / XXXK
99238	FIR L VIV	FIR L VIV / UKLV / UKR
99239	FIR LA PAZ	FIR LA PAZ / SLLF / BOL
99240	FIR LAHORE	FIR LAHORE / OPLR / PAK
99241	FIR LANGEN	FIR LANGEN / EDGG / D
99242	FIR LANZHOU	FIR LANZHOU / ZLHW / CHN

99243	FIR LILONGWE_L	FIR LILONGWE_L / FWLL / ZWE
99244	FIR LILONGWE_U	FIR LILONGWE_U / FWLL / ZWE
99245	FIR LIMA	FIR LIMA / SPIM / PRU
99246	FIR LISBOA	FIR LISBOA / LPPC / POR
99247	FIR LJUBLJANA	FIR LJUBLJANA / LJLA / SVN
99248	FIR LONDON	FIR LONDON / EGTT / G
99249	FIR LOS ANGELES	FIR LOS ANGELES / KZLA / USA
99250	FIR LUANDA_L	FIR LUANDA_L / FNAN / AGL
99251	FIR LUANDA_U	FIR LUANDA_U / FNAN / AGL
99252	FIR LUSAKA_L	FIR LUSAKA_L / FLFI / ZMB
99253	FIR LUSAKA_U	FIR LUSAKA_U / FLFI / ZMB
99254	FIR MADRID	FIR MADRID / LECM / E
99255	FIR MAGADAN OCEANIC EAST	FIR MAGADAN OCEANIC EAST / UHMM / RUS
99256	FIR MAGADAN OCEANIC WEST	FIR MAGADAN OCEANIC WEST / UHMM / RUS
99257	FIR MAGADAN SOKOL EAST	FIR MAGADAN SOKOL EAST / UHMM / RUS
99258	FIR MAGADAN SOKOL WEST	FIR MAGADAN SOKOL WEST / UHMM / RUS
99259	FIR MAIQUETIA	FIR MAIQUETIA / SVZM / VEN
99260	FIR MALE	FIR MALE / VRMF / MLD
99261	FIR MALTA	FIR MALTA / LMMM / MLT
99262	FIR MANILA	FIR MANILA / RPHI / PHL
99263	FIR MARSEILLE	FIR MARSEILLE / LFMM / F
99264	FIR MAURITIUS	FIR MAURITIUS / FIMM / MAU
99265	FIR MAZATLAN OCEANIC	FIR MAZATLAN OCEANIC / MMFO / MEX
99266	FIR MELBOURNE	FIR MELBOURNE / YMMM / AUS
99267	FIR MEMPHIS	FIR MEMPHIS / KZME / USA
99268	FIR MENDOZA	FIR MENDOZA / SAMF / ARG
99269	FIR MEXICO	FIR MEXICO / MMFR / MEX
99270	FIR MIAMI	FIR MIAMI / KZMA / USA
99271	FIR MIAMI OCEANIC	FIR MIAMI OCEANIC / KZMA / USA
99272	FIR MILANO	FIR MILANO / LIMM / I
99273	FIR MINNEAPOLIS	FIR MINNEAPOLIS / KZMP / USA
99274	FIR MINSK	FIR MINSK / UMMM / BLR
99275	FIR MOGADISHU	FIR MOGADISHU / HCSM / SOM
99276	FIR MONCTON SOUTHERN	FIR MONCTON SOUTHERN / CZQM / USA
99277	FIR MONTEVIDEO	FIR MONTEVIDEO / SUEO / URG
99278	FIR MONTREAL	FIR MONTREAL / CZUL / CAN
99279	FIR MOSCOW	FIR MOSCOW / UUWV / RUS
99280	FIR MUMBAI	FIR MUMBAI / VABF / IND
99281	FIR MUNICH	FIR MUNICH / EDMM / D
99282	FIR MURMANSK OCEANIC EAST	FIR MURMANSK OCEANIC EAST / ULMM / RUS
99283	FIR MURMANSK OCEANIC WEST	FIR MURMANSK OCEANIC WEST / ULMM / RUS
99284	FIR MUSCAT	FIR MUSCAT / OOMM / OMN
99285	FIR N DJAMENA	FIR N DJAMENA / FTTT / ASE
99286	FIR NADI EAST	FIR NADI EAST / NFFF / NHB
99287	FIR NADI WEST	FIR NADI WEST / NFFF / NHB
99288	FIR NAIROBI_L	FIR NAIROBI_L / HKNA / KEN
99289	FIR NAIROBI_U	FIR NAIROBI_U / HKNA / KEN
99290	FIR NASSAU	FIR NASSAU / MYNA / BAH
99291	FIR NAURU	FIR NAURU / ANAU / NRU
99292	FIR NEW YORK	FIR NEW YORK / KZWY / CAN

99293	FIR NEW YORK OCEANIC	FIR NEW YORK OCEANIC / KZNY / USA
99294	FIR NEW ZEALAND	FIR NEW ZEALAND / NZZC / NZL
99295	FIR NIAMEY	FIR NIAMEY / DRRR / ASE
99296	FIR NICOSIA	FIR NICOSIA / LCCC / CYP
99297	FIR NORWAY	FIR NORWAY / ENOR / NOR
99298	FIR NOVOSIBIRSK	FIR NOVOSIBIRSK / UNNT / RUS
99299	FIR NUKUS	FIR NUKUS / UTNR / XXU
99300	FIR OAKLAND	FIR OAKLAND / KZAK / USA
99301	FIR OAKLAND OCEANIC EAST	FIR OAKLAND OCEANIC EAST / KZOA / USA
99302	FIR OAKLAND OCEANIC WEST	FIR OAKLAND OCEANIC WEST / KZOA / USA
99303	FIR ODESA	FIR ODESA / UKOV / UKR
99304	FIR OSH	FIR OSH / UAFO / XKK
99305	FIR PANAMA	FIR PANAMA / MPZL / PNR
99306	FIR PARAMARIBO	FIR PARAMARIBO / SMPM / SUR
99307	FIR PARIS	FIR PARIS / LFFF / F
99308	FIR PHNOM PENH	FIR PHNOM PENH / VDPP / KMR
99309	FIR PIARCO	FIR PIARCO / TTZP / BRB
99310	FIR PORT AU PRINCE	FIR PORT AU PRINCE / MTEG / HTI
99311	FIR PORT MORESBY	FIR PORT MORESBY / AYPY / PNG
99312	FIR PRAHA	FIR PRAHA / LKAA / CZE
99313	FIR PUERTO MONTT	FIR PUERTO MONTT / SCTZ / CHL
99314	FIR PUNTA ARENAS	FIR PUNTA ARENAS / SCCZ / CHL
99315	FIR PYONGYANG	FIR PYONGYANG / ZKKP / KRE
99316	FIR RECIFE	FIR RECIFE / SBRE / B
99317	FIR REIMS	FIR REIMS / LFEE / F
99318	FIR RESISTENCIA	FIR RESISTENCIA / SARR / ARG
99319	FIR REYKJAVIK	FIR REYKJAVIK / BIRD / ISL
99320	FIR RIGA	FIR RIGA / EVRR / LVA
99321	FIR ROBERTS	FIR ROBERTS / GLRB / ROB
99322	FIR ROCHAMBEAU	FIR ROCHAMBEAU / SOOO / FGU
99323	FIR ROMA	FIR ROMA / LIRR / I
99324	FIR ROSTOV-NA-DONU	FIR ROSTOV-NA-DONU / URVV / RUS
99325	FIR SAL OCEANIC	FIR SAL OCEANIC / GVSC / CPV
99326	FIR SALT LAKE	FIR SALT LAKE / KZLC / USA
99327	FIR SAMARA	FIR SAMARA / UWWW / RUS
99328	FIR SAMARKAND	FIR SAMARKAND / UTSD / XXU
99329	FIR SAN JUAN	FIR SAN JUAN / TJZS / PTR
99330	FIR SANA A	FIR SANA A / OYCS / YEM
99331	FIR SANKT-PETERBURG	FIR SANKT-PETERBURG / ULLL / RUS
99332	FIR SANTA MARIA OCEANIC	FIR SANTA MARIA OCEANIC / LPPO / POR
99333	FIR SANTIAGO	FIR SANTIAGO / SCEZ / CHL
99334	FIR SANTO DOMINGO	FIR SANTO DOMINGO / MDCS / DOM
99335	FIR SANYA	FIR SANYA / NA / CHN
99336	FIR SARAJEVO	FIR SARAJEVO / LQSB / BIH
99337	FIR SCOTTISH	FIR SCOTTISH / EGPX / G
99338	FIR SEATTLE	FIR SEATTLE / KZSE / USA
99339	FIR SEYCHELLES	FIR SEYCHELLES / FSSS / SEY
99340	FIR SHANGHAI	FIR SHANGHAI / ZSHA / CHN
99341	FIR SHANNON	FIR SHANNON / EISN / IRL
99342	FIR SHANWICK OCEANIC	FIR SHANWICK OCEANIC / EGGX / G

99343	FIR SHENYANG	FIR SHENYANG / ZYSH / CHN
99344	FIR SHYMKENT	FIR SHYMKENT / UAII / XXXK
99345	FIR SIMFEROPOL	FIR SIMFEROPOL / UKFV / UKR
99346	FIR SINGAPORE	FIR SINGAPORE / WSJC / SNG
99347	FIR SOFIA	FIR SOFIA / LBSR / BUL
99348	FIR SONDRESTROM_L	FIR SONDRESTROM_L / BGGL / DNK
99349	FIR SONDRESTROM_U	FIR SONDRESTROM_U / BGGL / DNK
99350	FIR SWEDEN	FIR SWEDEN / ESAA / S
99351	FIR SWITZERLAND	FIR SWITZERLAND / LSAS / SUI
99352	FIR TAHITI	FIR TAHITI / NTTT / OCA
99353	FIR TAIBEI	FIR TAIBEI / RCTP / TWN
99354	FIR TALLINN	FIR TALLINN / EETN / EST
99355	FIR TASHKENT	FIR TASHKENT / UTTR / XXU
99356	FIR TBILISI	FIR TBILISI / UGGG / GEO
99357	FIR TEHRAN	FIR TEHRAN / OIIX / IRN
99358	FIR TEL AVIV	FIR TEL AVIV / LLTA / ISR
99359	FIR TIRANA	FIR TIRANA / LAAA / ALB
99360	FIR TORONTO	FIR TORONTO / CZYZ / CAN
99361	FIR TRIPOLI_L	FIR TRIPOLI_L / HLLL / LBY
99362	FIR TRIPOLI_U	FIR TRIPOLI_U / HLLL / LBY
99363	FIR TUNIS_L	FIR TUNIS_L / DTTC / TUN
99364	FIR TUNIS_U	FIR TUNIS_U / DTTC / TUN
99365	FIR TURKMENABAT	FIR TURKMENABAT / UTAV / XTT
99366	FIR TURKMENBASHI	FIR TURKMENBASHI / UTAK / XTT
99367	FIR TYUMEN ROSCHINO	FIR TYUMEN ROSCHINO / USTR / RUS
99368	FIR UJUNG PANDANG	FIR UJUNG PANDANG / WAAZ / INS
99369	FIR ULAN BATOR	FIR ULAN BATOR / ZMUB / MON
99370	FIR URUMQI	FIR URUMQI / ZWUQ / CHN
99371	FIR VANCOUVER	FIR VANCOUVER / CZVR / CAN
99372	FIR VIENTIANE	FIR VIENTIANE / VLVT / LAO
99373	FIR VILNIUS	FIR VILNIUS / EYVL / LTU
99374	FIR WARSZAWA	FIR WARSZAWA / EPWW / POL
99375	FIR WASHINGTON	FIR WASHINGTON / KZDC / USA
99376	FIR WIEN	FIR WIEN / LOVV / AUT
99377	FIR WINDHOEK_L	FIR WINDHOEK_L / FYWH / NMB
99378	FIR WINDHOEK_U	FIR WINDHOEK_U / FYWH / NMB
99379	FIR WINNIPEG	FIR WINNIPEG / CZWG / CAN
99380	FIR WUHAN	FIR WUHAN / ZHWH / CHN
99381	FIR YAKUTSK	FIR YAKUTSK / UEEE / RUS
99382	FIR YANGON	FIR YANGON / VYYF / BRM
99383	FIR YEKATERINBURG	FIR YEKATERINBURG / USSS / RUS
99384	FIR YEREVAN ZVARTNOTS	FIR YEREVAN ZVARTNOTS / UGEE / ARM
99385	FIR ZAGREB	FIR ZAGREB / LDZO / HRV

Appendix H

Methodology for calculating separation distances and interference contours in Frequency Finder

1. Introduction

1.1 This Appendix clarifies the methodology and background that has been applied in Frequency Finder to determine and present compatibility or incompatibility between frequency assignments, including the presentation of the interference contours.

1.2 The ICAO *Handbook on radio frequency spectrum requirements for civil aviation* (Doc 9718) has been expanded to include Volume II *Frequency assignment planning criteria for aeronautical radio communication and navigation systems*. Chapter II of this Volume describes in detail the principles for establishing the frequency assignment planning criteria for VHF air/ground communication systems operating in the frequency band 117.975 – 137 MHz (voice and data). The frequency planning criteria that have been implemented in Frequency Finder are using the criteria as contained in Annex 10:

> The geographical separation between facilities working on the same frequency shall, except where there is an operational requirement for the use of common frequencies for groups of facilities, be such that the frequency protected service volume coverage of each facility is separated from the frequency protected service volume of the other facility by a distance not less than that required to provide a desired to undesired signal ratio of 20 dB or by a separation distance not less than the sum of the distances to associated radio horizon of each service volume, whichever is smaller
>
> *The application of the minimum separation distance based on the sum of the radio horizon distance of each facility assumes that it is highly unlikely that two aircraft will be at the closest points between and at the maximum altitude of the frequency protected service volume of each facility.*

The distance to the radio horizon from a station in an aircraft is normally given by the formula:

$$D = K \sqrt{h}$$

where D = *distance in nautical miles;*
h = *height of the aircraft station above earth;*
K = *(corresponding to an effective earth's radius of 4/3 of the actual radius);*
= *2.22 when* h *is expressed in metres; and*
= *1.23 when* h *is expressed in feet.*

1.2.1 Although Annex 10 also contains provisions using the 14 dB D/U signal protection ratio as an alternative method, this has not been implemented in Frequency Finder. This method requires information on the actual transmitter power. Such data is not readily available in the frequency database (COM lists) for VHF air/ground frequencies.

Note 1: If desired, the 5:1 distance ratio which in a way simulates the 14 dB D/U protection ratio can be implemented in Frequency Finder. This method is used in the EUR Region with recognition of the absence of data on actual transmitter power.

Note 2: More information on the development and the application of geographical separation criteria is contained in the Handbook (Doc 9718), Volume II.

1.3 Interference contours

1.3.1 For the purpose of presenting interference areas with Frequency Finder, the concept of interference contours has been introduced. The interference contour is basically the location of those points at a distance from a potentially interfering (transmitting) station where the agreed frequency assignment planning criteria are satisfied.
When the (victim) receiver is at a distance from the interfering transmitter station that is within the interference contour, the agreed frequency assignment planning criteria are not satisfied and harmful interference is predicted.

1.3.2 To prevent harmful interference between aircraft the agreed minimum separation distance between the interfering aircraft and the victim aircraft needs to be, as a minimum, the sum of the distance to the radio horizon of each aircraft. The interference contour around the (single, interfering) aircraft is a circle with the radius of the sum of the distance to the radio horizon of the transmitter and the receiver. To secure protection for aircraft operating throughout the coverage of the (interfering) facility, the interference contour becomes a “buffer” zone around the coverage of the interfering facility with a width equal to the sum of the distance to the radio horizon of the transmitter and the receiver.

1.3.3 For a circular service, the interference contour is a circle with a radius of $R_A+R_{HA}+R_{HB}$ where R_A is the radius of the designated operational coverage of the circular (interfering) service; R_{HA} is the distance to the radio horizon of the transmitter operating at the edge of the designated operational coverage and at maximum height and R_{HB} is the distance to the radio horizon of the victim receiver as shown in Figure H-1. The width of the buffer zone is equal to $R_{HA}+R_{HB.}$

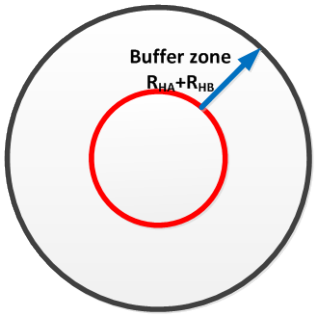


Figure H-1 Example of buffer zone (interference contour) for a circular service

1.3.4 In case the interfering transmitter is operating in an area service, the interference contour is a buffer zone around the area service as shown in Figure H-2. Also in this case, the width of the buffer zone is equal to $R_{HA}+R_{HB.}$

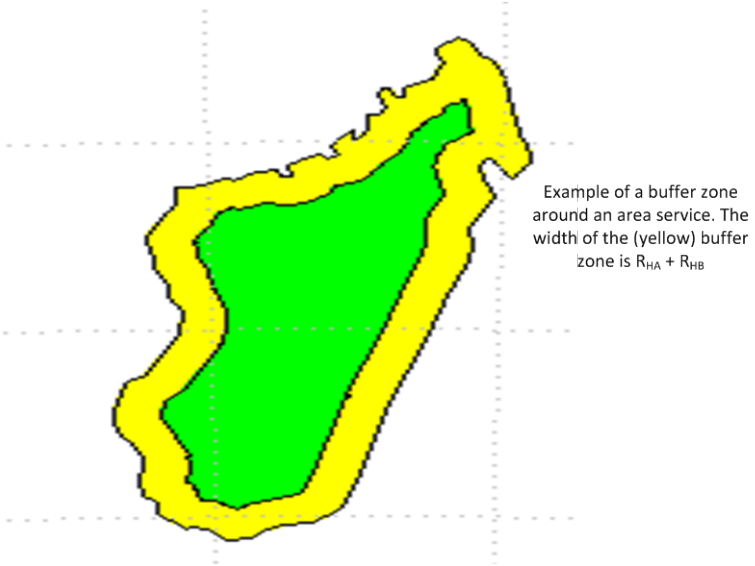


Figure H-2 Example of buffer zone (interference contour) for an area service (e.g. FIS)

1.3.5 When the interference contour as presented in Figures H-1 and H-2 overlaps with the designated operational coverage of the (victim) facility, interference is predicted. Frequency Finder calculates the coordinates of the area within which such interference is predicted for presentation on a map as further clarified below.

2. Minimum co-frequency separation distances and calculation of interference contours when both facilities are providing air/ground communication services.

2.1 *Interference contour between circular services.* The agreed minimum co-frequency separation distance between VHF air/ground communication systems which are both providing a circular service has been established as shown in Figure H-3:

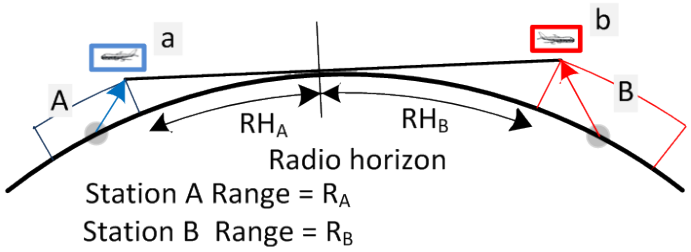


Figure H-3 Separation based on radio line-of-sight

The minimum separation between the ground facilities (or rather between the DOC for co-frequency facilities) is calculated with: $\mathbf{R_A + RH_A + RH_B + R_B}$. **(1)**

Note: For more information see the ICAO Handbook on radio frequency spectrum requirements for civil aviation, Volume II (Doc. 9718).

Frequency Finder calculates for circular services the protection of the Designated Operational Coverage from the coordinates (center of the DOC) which is provided for in the COM lists. Although in most cases this location is the same as the location of the ground stations, in practice the actual location of the transmitter may be off-center (or even outside the Designated Operational Coverage) without affecting frequency assignment planning since the protection from air-to-air interference requires larger separation distances compared to interference involving a ground station.
In any case, the (potentially interfering) ground transmitter needs to be located below the radio horizon of the victim aircraft receiver. However, relevant data is not provided in the COM lists and therefore cannot be tested. This may lead in some to inconsistencies in frequency assignment planning, in particular when assessing adjacent frequency compatibility.

Figure H-4 shows an example where the two services, operating on the same frequency, meet the minimum separation requirements.

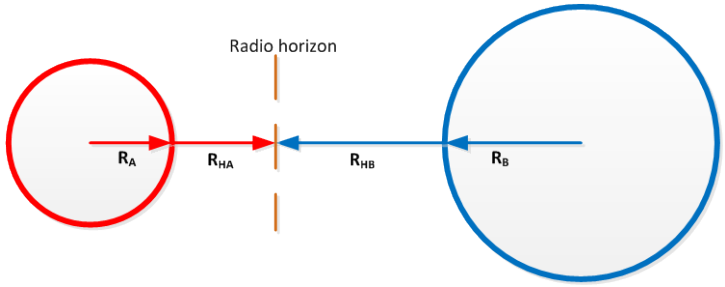


Figure H-4 Separation based on radio line-of-sight as in Figure H-1; seen from above

2.1.2 Frequency Finder has implemented the concept of interference contours and plots these on the map when the minimum separation distance requirements are NOT met. The basics for calculating the interference contours and buffer zones are described in §1 above.

When both facilities have a circular DOC, provide air/ground communications and the minimum agreed separation distance between the facilities is not met, the interference contour can be calculated as a circle (segment) with two arcs as presented in Figure H-5. One arc is calculated from the center of the interfering service with a radius equal to $\mathbf{R_A + R_{HA} + R_{HB}}$ and the other arc, which is delimited by the designated operational coverage of the interfered (victim) facility. Has the radius $\mathbf{R_B}$. The area enclosed by the two arcs is the interference area where the minimum separation criteria are not met and interference can be expected.

Frequency Finder calculates the actual distance between the two facilities. In case the distance is less than the agreed frequency assignment planning criteria permit, the interference contours are established and the interference areas are presented on the map. In turn, each of the two facilities is considered the interferer and the other the victim (interference from facility A into facility B and vice versa).

This concept is shown in Figure H-5.

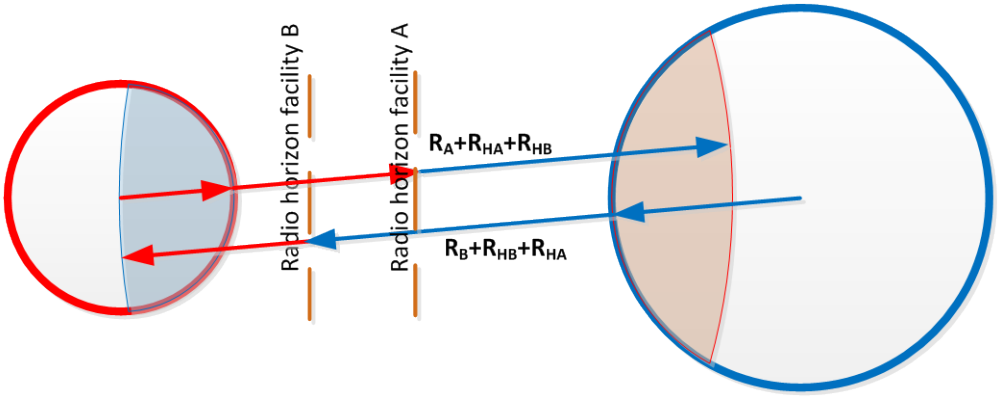


Figure H-5 Interference contours for two circular services

Note 1: the shaded areas represent the areas where interference can be expected.
Note 2: the distance to the radio horizon R_{HA} or R_{HB} is measured from the edge of the coverage

Figure H-6 shows how the interference as depicted in Figure H-5 is presented with Frequency Finder:

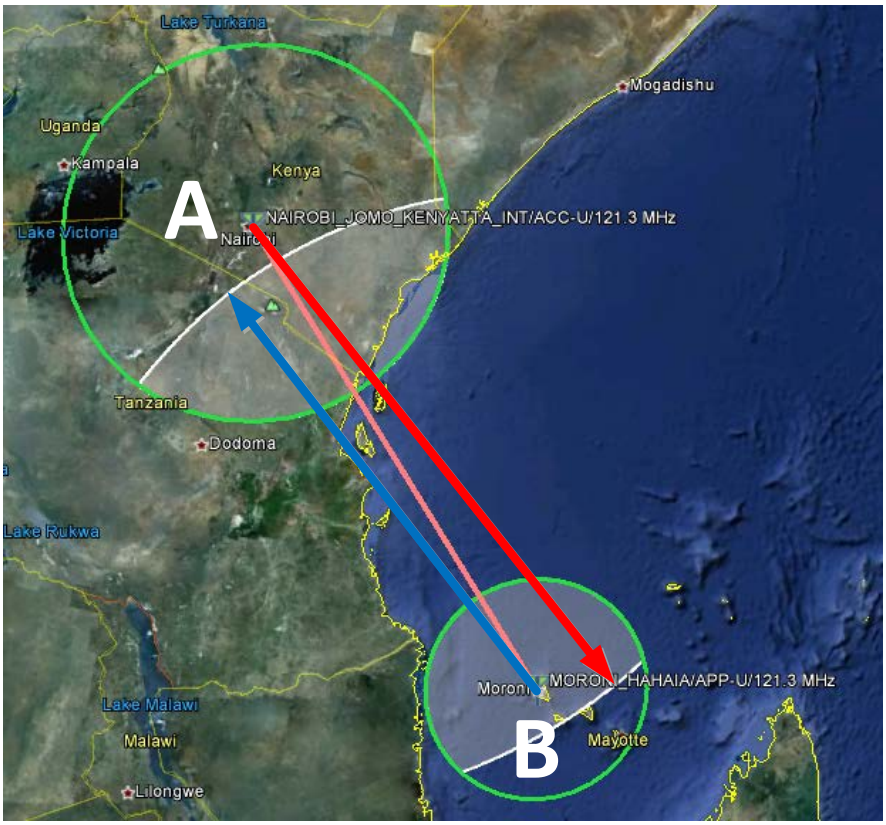


Figure H-6 Interference between two facilities with a circular DOC as presented with Frequency Finder

In Figure H-6 facility A has a designated operational coverage (DOC) of 261/450. The distance to the radio horizon for this facility is 260 NM. Facility B has a DOC of 150/450 and the distance to the radio horizon of this facility is also 260 NM. The radius of the segment (overlap of the interference contour within the DOC) shows the interference area from facility A into facility B and is $R_A+R_{HA}+R_{HB}$ = 261+260+260 = 781 NM as shown by the red arrow in Figure H-6. The radius of the interference contour showing interference from facility B into facility A is $R_B+R_{HB}+R_{HA}$ = 150+260+260 = 670 NM as shown by the blue arrow in Figure H-6. The overlap of this interference contour with the DOC of facility A shows the area in the DOC of station A where the agreed frequency assignment planning criteria are not met an interference is expected. The pink line connecting the two facilities is just indicating on the map that these facilities do not meet the ICAO minimum separation requirements.

2.2 *Interference contour between an area service and a circular service.* The minimum co-frequency separation distance between VHF air/ground communication systems when one facility is providing a circular service and the other is providing an area service is established along the same principles as clarified in §1 and shown in Figure H-3 above (the agreed minimum separation distance between the edge of the coverage of the two facilities is greater than the sum of the distance to the radio horizon of the respective facilities).

In this case, Frequency Finder calculates the actual distance of the closest point of the area service to the center of the circular service. For compatible frequency assignments, the actual separation distance needs to be greater than $\mathbf{R_{HA} + R_{HB} + R_B}$ when facility B is providing the circular service.

In Figure H-7, the distance between the closest points on the edge of the area service (point X) to the edge of the circular service B is less than $R_{HA}+R_{HB}$. The interference contour which is showing the location of the points *within* the area service A where the frequency assignment planning criteria are met is an arc with the radius $\mathbf{R_A + RH_A + RH_B}$

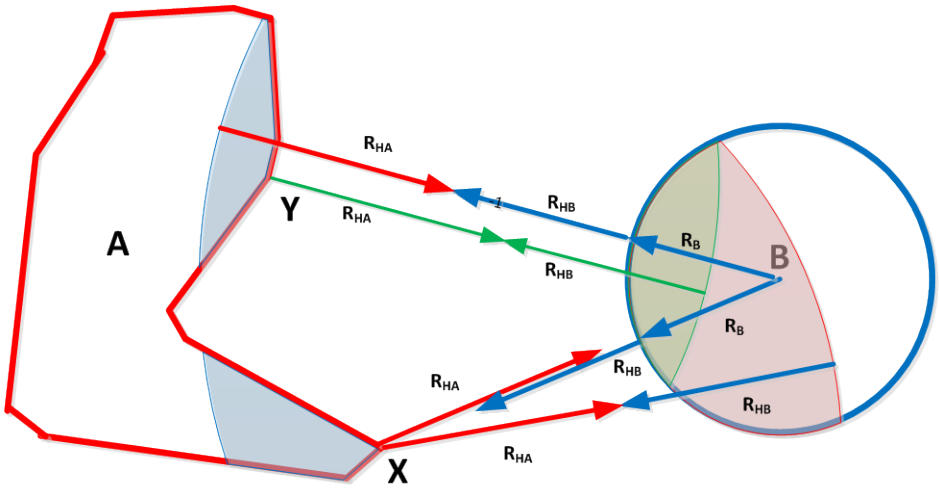


Figure H-7 Interference contours for one area service and one circular service

To calculate the area of interference from stations operating in the area service A into the circular service B, Frequency Finder determines form the closest point of the area service to the circular service (Point X in Figure H-7) and calculates the interference contour as an arc with the radius $\mathbf{R_{HA}+R_{HB}}$ and as center Point X. The area where the interference contour overlaps with the (circular) service B is the area where the agreed frequency assignment planning criteria are not met and harmful interference is expected.

Frequency Finder *only* calculates the interference contour for interference in circular service area B from the closest point of the area service (point X in Figure H-5). There may be other points from where also interference can be caused (e.g. from point Y in Figure H-5), but the closest point is assumed to present the worst case.
Note: Frequency Finder can be modified to calculate and present the interference contours from other point at the edge of the area service. This would however introduce complex calculations that would take quite some time to more precisely establish the contour of the interference area in circular service B. The presentation of the interference areas using only one point from the area service gives a reasonable indication of the area where interference in circular service B is expected.

Figure H-8 shows how the interference as depicted in Figure H-7 is presented with Frequency Finder:

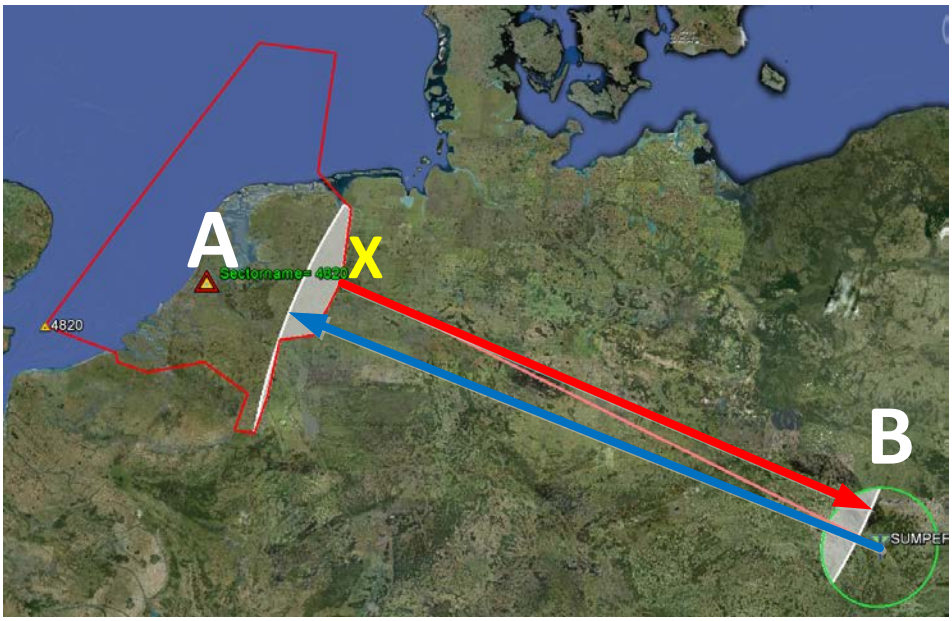


Figure H-8 Interference between facilities with a circular DOC and an area DOC as is presented with Frequency Finder

In Figure H-8 facility A is an area service as shown by the red polygon with a designated operational height of FL 350 (35000 ft.). The distance to the radio horizon for this facility is 230 NM. Facility B has a DOC of 40/150 and the distance to the radio horizon for this facility is 151 NM. The radius of the segment (interference contour) showing interference from facility A into the designated operational coverage of facility B as measured from point X is $R_{HA}+R_{HB}$ = 230+151 = 381 NM as shown by the red arrow in Figure H-8. The range of the interference contour showing interference from facility B into the designated operational coverage of facility A is $R_B+R_{HB}+R_{HA}$ = 40+151+230 = 421 NM as shown by the blue arrow in Figure H-8. The pink line connecting the two facilities is indicating on the map that these facilities do not meet the ICAO minimum separation requirements.

2.3 *Interference contours between two area services.* When both facilities are providing an area service (ACC, FIR) again the same principles as presented in §1 apply, i.e. the designated operational coverage (DOC) of each of the two area services need to be separated by at least the sum of the distance to the radio horizon for each facility measured from the closest point of the respective area services.

In Figure H-9, the distance between the closest points of the edge of the two area services A and B is between point X and point Y. Since this distance is less than the minimum distance required, interference in both the designated operational coverage for facility A and facility B can be expected.

The interference contours that are being calculated with Frequency Finder have a radius of $\mathbf{R_{HA}+R_{HB}}$ and are measured from the (closest) points X and Y.

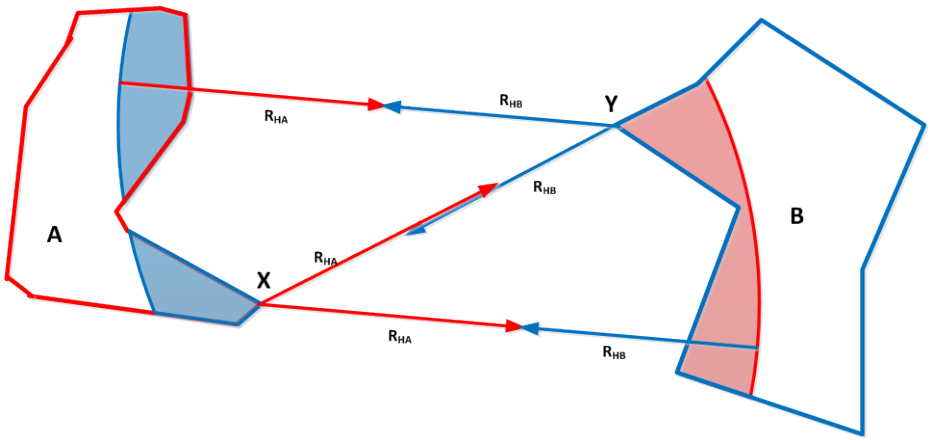


Figure H-9 Interference contours for two area services

Frequency Finder searches for the closest points between the two area services (points X and Y in Figure H-9), calculates the actual distance between them and tests if the minimum separation distance requirements as per the ICAO agreed frequency assignment planning criteria is satisfied (the actual separation distance need to be greater than the sum of the distance to the radio horizon of the respective facilities). If this is not the case, the interference contours are established and the area that is inside the interference contour and the designated operational coverage of the relevant area service is plotted on the map

Note 1: in case the contour of the respective area services is determined by a large number of points, the determination of the points with the closest distance between the area services may be time consuming.
Note 2: To provide intelligible results, the coordinates of the polygons need to be ordered in a clock-wise direction and closed (i.e. the last point in the table of coordinates for a polygon needs to have the same coordinates as the first point).

Figure H-10 shows how the interference as depicted in Figure H-9 is presented with Frequency Finder:

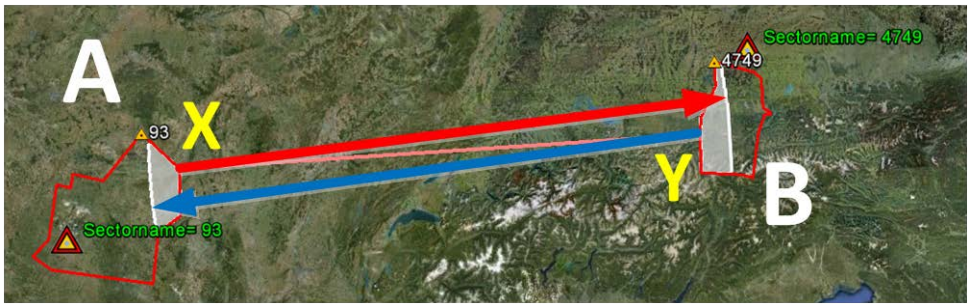


Figure H-10 Interference contours for two area services as is presented with Frequency Finder

In Figure H-10 both facilities A and B provide an area service as shown by the red polygons. The designated operational height of area service A is FL 150 (15000 ft.) and of area service B is FL 275 (27500 ft.). The distance to the radio horizon for these services is 151 NM and 204 NM respectively. As demonstrated above, the radius of both interference contours is equal to the RHA+RHB = 355 NM.

Frequency Finder only shows the interference contours for the closest points between the area services; there may be other point on at the edge of each are service which also do not meet the minimum separation distance requirements and result in different interference contours.

For area services, the protection that is being calculated in Frequency Finder is throughout the area including cases where the area is larger than can be covered by one or more registered ground facilities. When other (co-frequency) ground facilities have been entered in the global database to improve the coverage of the VHF frequency and are operating as extended range facility (using the ICAO off-set carrier or CLIMAX system) these stations are identified as member of an extended range family in the database. These stations are not considered as interferer *between* each other. This method of providing protection to a particular frequency assignment would allow for additional (Extended Range) facilities to be implemented without the need for a new frequency assignment.

3. Minimum co-frequency separation distances and calculation of interference contours involving aeronautical broadcast services operating on the same frequency.

3.1 Both facilities provide a broadcast service (ATIS, VOLMET)

3.1.1 The minimum separation distance between two (co-frequency) aeronautical broadcast services has been established (Re. ICAO *Handbook on radio frequency spectrum requirements, Volume II*) as follows based on the geometry as reproduced in Figure H-11:

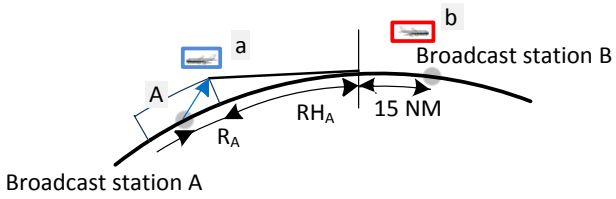


Figure H-11 Interference mechanism between broadcast services

Since each broadcast station may provide service to different DOC's (range and/or height), calculation of the minimum separation distance needs to consider the designated operational range and height for each station; the resulting minimum separation distance between the two ground stations is

$$\textbf{(Max) } RH_A + R_A + 15 \textbf{ or } RH_B + R_B + 15$$

Where: R_A is the designated operational range for ground broadcasting station "A"
R_B is the designated operational range for ground broadcasting station "B"
RH_A is the distance to the radio horizon of aircraft A
RH_B is the distance to the radio horizon of aircraft B

Note 1: distances in Frequency Finder are measured / calculated in NM
Note 2: Aeronautical broadcast systems do not involve transmissions from an aircraft.

The interference contour through which the interference from an incompatible broadcast facility can be presented inside the coverage of the other facility in case the minimum separation criteria are not met has a radius of RH_X+15 NM where RH_x is the distance to the radio horizon of the facility that is being interfered. The center of the arc of the interference contour is the location of the (ground based) aeronautical broadcast transmission.

In Figure H-12 the interference contours between aeronautical broadcast services is presented for the case where both broadcast services interfere with each other:

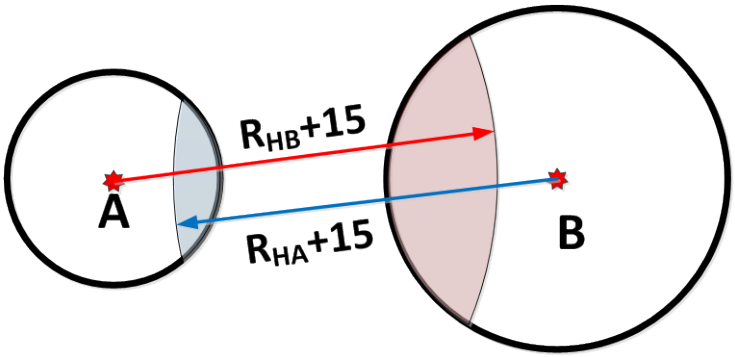


Figure H-11 Interference mechanism between broadcast services

In the example in Figure H-11 the actual separation distance between the broadcast facilities A and B is less than R_A+R_{HA}+15 and also less than R_B+R_{HB}+15, meaning that both facilities interfere with each other. Depending on the local situation (actual separation distance and DOC of the respective broadcast services, one broadcast station can be interfered while the other is protected (e.g. in case the conditions in the formula **(Max) RH_A + R_A + 15 or RH_B + R_B + 15** are met for **RH_A + R_A + 15** but are not met for **RH_B + R_B + 15.**

Figure H-12 shows the presentation in Frequency Finder of interference between two broadcast (VOLMET) services

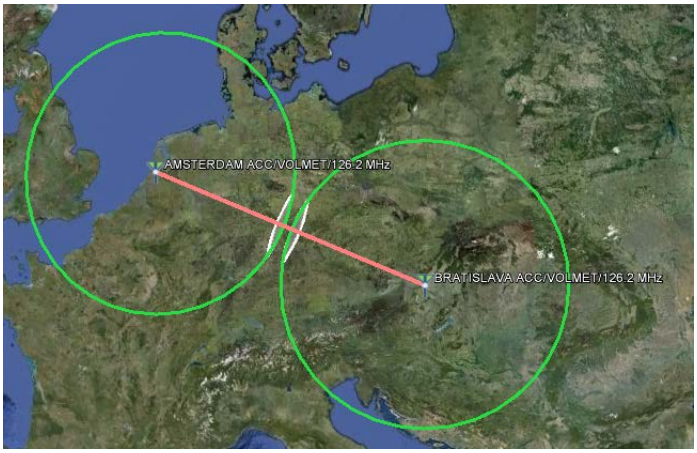


Figure H-12 Interference mechanism between circular broadcast services as presented with Frequency Finder

Note: VOLMET services are typically deployed up to the maximum range that is achievable.

3.2 One facility provides an air/ground service and the other facility provides a broadcast service (ATIS, VOLMET).

In this case, the compatibility of the station providing air/ground communications, as interferer into the broadcast service, needs to be established using the method as described in §2.1 and §2.2. (See also the Handbook, Volume II, Doc 9718). The interference contour from the facility that is providing the air/ground communication service is to be based on the need to separate the designated operational coverage of the two facilities with the sum of the distances to the respective radio horizon. Compatibility of the aeronautical broadcast service needs to be established as provided for in § 3.1 Figure H-13 shows the relevant interference paths (and interference contours).

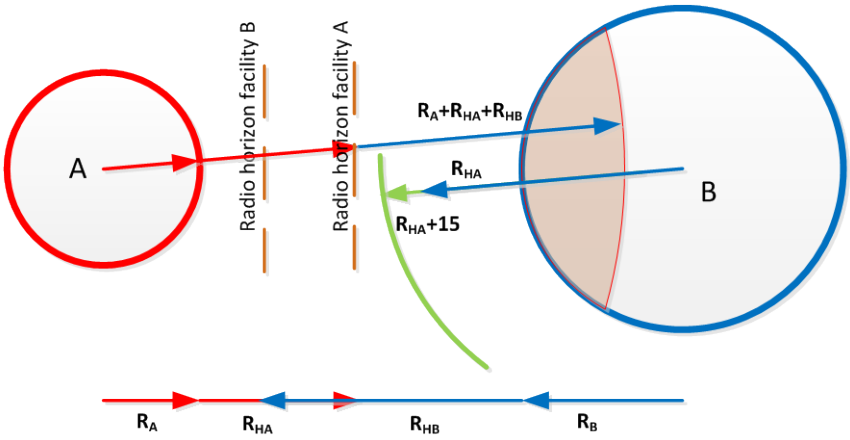


Figure H-13 Interference mechanism between broadcast services; interference contours

In Figure H-13, facility A is providing a (circular) air/ground communication service and facility B is providing a (circular) aeronautical broadcast service. To protect the broadcast service of facility B from interference from aircraft operating in the DOC of facility A, the minimum separation distance between the two ground stations needs to be $\mathbf{R_A+R_{HA}+R_{HB}+R_B}$. If this minimum separation distance is not satisfied, as presented in Figure H-12, the interfered area of facility B is described with the interference contour which, from facility A has a radius of $\mathbf{R_A+R_{HA}+R_B}$. This is the same interference contour as described in §2.1.2 and Figure H-5.
The interference contour from the broadcast facility B has a radius of $\mathbf{R_{HA}+15}$ (NM). In the example in Figure H-13 this interference contour does not overlap with the DOC of facility A and, as a result, the operation of the broadcast facility B does not cause harmful interference to aircraft operating within the DOC of facility A.

In cases where facility A is providing a area air/ground communication service, the radius of the interference contour *which is for area services* measured from the closest point of the area service to the aeronautical broadcast service is $\mathbf{R_{HA}+R_{HB}}$. The minimum separation distance to prevent interference from area service A into broadcast service B is $\mathbf{R_{HA}+R_{HB}+R_B}$.

Should however the separation distance between facility B and facility A be less than **R_{HA}+15** (NM), the interference contour from facility B overlaps with the coverage of facility A and the interference can be presented with the overlapping interference contour with the radius **R_{HA}+15**, from station B.

In cases where the facility A provides an area air/ground communication service, the radius of the interference contour from facility A into facility B in Figure H-13 will be **R_{HA}+R_{HB}** and measured from the closest point of the area service to the (circular) aeronautical broadcast service. This is the same condition as clarified in paragraph 2.2 above.

Figure H-14 shows the presentation of interference between an area air/ground communication service and a broadcast service with Frequency Finder. Note that interference is foreseen into the broadcast service (from airborne transmissions inside the DOC of the area service) but no interference is expected from transmissions of the broadcast service into the area service.

Figure H-13 Presentation of interference between an (area) air/ground service and a broadcast service in Frequency Finder

4. Calculation method and presentation calculation results for co-frequency compatibility in Frequency Finder.

4.1 Frequency Finder follows the following steps to calculate and determine compatibility between frequency assignments in the global COM list.

a) The actual separation distance between facilities is determined; for circular services this distance is between the locations as provided in the COM list. For area services, this is the distance of the closest point (of the area service) to the

circular service or the distance between the closest points between the area services.

b) The minimum required separation distance, based on either the type of service or the provided DOC of the services is established in accordance with Table 1
c) The radius and the origin (center) of the interference contours between the service being tested and each of the co-frequency assignments within a range of at least 1020 NM from the tested station is established (in both directions; interference to and interference from the facility being tested). The radius of the interference contours is established in accordance with Table 1

4.2 The calculation results are in accordance with the provision of the ICAO frequency assignment planning criteria as contained in the Handbook on radio frequency spectrum requirements, Volume II and the data presented in the COM list.

4.3 For each frequency assignment Frequency Finder calculates the range R_A and the distance to the radio horizon (R_{HA}) on the basis of specific information contained in the COM list. This information is either provided directly by States or derived from the table of uniform values for the designated operational coverage for certain services (e.g. TWR, APP/L and CC/U). This table is incorporated in the ICAO *Handbook on radio frequency spectrum requirements for civil aviation, Volume II* (DOC 9718). This method permits the use of designated operational coverage areas that are tailored to the minimum operational requirements and improves efficient frequency utilization. More information is contained in this Handbook, Volume II.

4.4 Area services

For area services, the protection that is being calculated in Frequency Finder is throughout, the area also in cases where the area is larger than can be covered by the ground station(s) that have been implemented. When other (co-frequency) ground facilities have been entered in the global database to improve the coverage of the VHF frequency and are operating as extended range facility (using the ICAO off-set carrier or CLIMAX system) these stations are identified in the database as a member of an Extended Range family. These stations are not considered as interferer between each other. This method of providing protection to a particular frequency assignment would allow for additional (Extended Range) facilities to be implemented for improving the coverage of an area service without the need for a new frequency assignment. Frequency Finder allows for these Extended Range families of stations being identified.

4.5 The distances for calculating compatibility and the interference contours that have been implemented in Frequency Finder are contained in Table H-1.

In this table, facility A is the facility that is being tested. Facility B is the facility against which facility A is being tested. Frequency Finder tests the (desired) facility against all co-frequency facilities that are located within a circle with a range of at least 1020 NM from the (desired) facility. Due to using the global database, interregional coordination is triggered, as required

Circ A/G - circular coverage; the service is providing air/ground communications
Area A/G - area coverage; the service is providing air/ground communications
Circ BC - circular coverage; the facility is providing aeronautical broadcast services.

Facility A	Facility B	Interference contour Facility A is interferer and facility B is victim	Interference contour Facility B is interferer and facility A is victim	Minimum separation distance between facilities A and B
Circ A/G	Circ A/G	**$R_A+R_{HA}+R_{HB}$** From ground station A	**$R_B+R_{HB}+R_{HA}$** From ground station B	**$R_A+R_{HA}+R_{HB}+R_B$** Between ground stations
Circ A/G	Area A/G	**$R_A+R_{HA}+R_{HB}$** From ground station A	**$R_{HB}+R_{HA}$** From closest point of area service B	**$R_A+R_{HA}+R_{HB}$** Between ground station A and area service B
Area A/G	Circ A/G	**$R_{HB}+R_{HA}$** From closest point of area service A	**$R_{HA}+R_{HB}+R_B$** From ground station B	**$R_B+R_{HB}+R_{HA}$** Between ground station B and area service A
Area A/G	Area A/G	**$R_{HA}+R_{HB}$** From closest point of area service A	**$R_{HB}+R_{HA}$** From closest point of area service B	**$R_{HA}+R_{HB}$** Between closest points of area services A and B
Circ BC	Circ A/G	**R_{HB}+15** From ground station A	**$R_B+R_{HB}+R_{HA}$** From ground station B	**$R_A+R_{HA}+R_{HB}+R_B$** Between ground stations
Circ A/G	Circ BC	**$R_A+R_{HA}+R_{HB}$** From ground station A	**R_{HA}+15** From ground station B	**$R_A+R_{HA}+R_{HB}+R_B$** Between ground stations
Circ BC	Area A/G	**R_{HB}+15** From ground station A	**$R_{HB}+R_{HA}$** From closest point of area service B	**$R_A+R_{HA}+R_{HB}$** Between ground station A and area service B
Area A/G	Circ BC	**$R_{HB}+R_{HA}$** From closest point of area service A	**R_{HA}+15** From ground station B	**$R_B+R_{HB}+R_{HA}$** Between ground station B and area service A
Circ BC	Circ BC	**R_{HB}+15** From ground station A	**R_{HA}+15** From ground station B	**(Max) R_A+R_{HA}+15 or R_B+R_{HB}+15** Between ground station A and B

Table H-1 Calculation of minimum separation distances and interference contours for co-frequency facilities (distances in NM)

5. Minimum adjacent frequency (25 kHz) separation distances

5.1 The agreed minimum separation distance between a transmitter and receiver station operating on adjacent frequencies is 10 NM. This implies that the designated operational coverage for facilities that are operating on adjacent frequencies need to be separated by at least 10 NM. (Re. ICAO *Handbook on radio frequency spectrum requirements for civil aviation*, Volume II, Doc 9718). This scenario is reproduced in Figure H-14

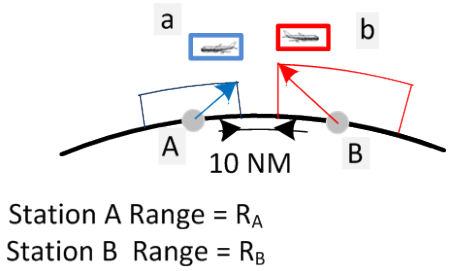


Figure H-14 Adjacent frequency separation for air-ground services

Following the same scenarios as described in paragraphs 2 and 3, the following criteria have been implemented in Frequency Finder for air/ground communication services.

5.1.1 Circular air/ground communication services.

The minimum separation distance between the two facilities is **R_A+10+R_B** as shown in Figure H-15

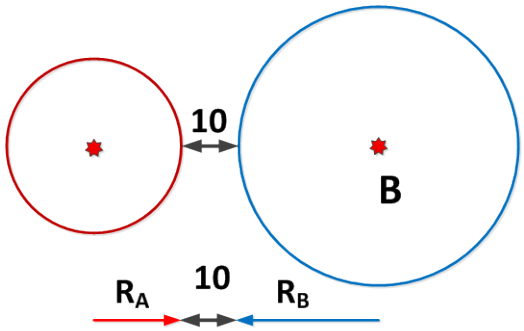


Figure H-15 Minimum separation between circular facilities operating on adjacent frequencies

When the minimum separation criteria between facilities operating on adjacent frequencies are not met, the interference contours have a radius of **R_A+10 NM** or **R_B+10 NM**. The interfered areas which present the overlapping of the interference contour with the designated operational coverage of the victim facility are shown in Figure H-16

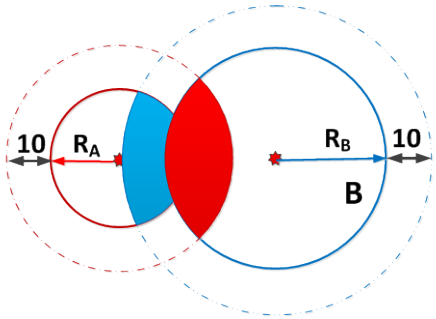


Figure H-16 Interference contours/areas between circular facilities operating on adjacent frequencies

5.1.2 Circular and area air/ground communication services operating on adjacent frequencies

When one of the facilities provide air/ground communications in a specified area (area service, ACC or FIS) and the other facility provides a air/ground communications in a circular area (TWR, APP) the minimum separation between the designated operational coverage of the facilities is calculated with **10+R_X**, where R_X is the radius of the circular service. In this case the minimum separation distance is calculated from the closest point of the area service to the circular service.

The interference contour from the area service, as is presented in Frequency Finder is a circle (segment) with a radius of 10 NM from the closest point of the area service to the circular service. There may be other points of the area service as well. In cases where adjacent frequency interference is expected, visual examination of the presentation of the interference on the map is recommended. Interference from the circular facility within the area service is presented with Frequency Finder with a circle segment within the area service with a radius of **R_X+10** where R_X is the radius of the circular service.

5.1.3 Both facilities provide an area service operating on adjacent frequencies.

When both facilities provide and area service, the minimum separation distance between the closest points of both area services is 10 NM. The interference contours are presented with Frequency Finder *only* for these points. Further investigation for potential other point of the area services may be necessary.

5.2 Following the same scenarios as described in paragraph 3, the following criteria have been implemented in Frequency Finder for aeronautical broadcast services.

5.2.1 Both facilities operating on adjacent frequencies provide an aeronautical broadcast service.

The agreed minimum separation distance between two aeronautical broadcast stations operating on adjacent frequencies is 13 NM between the edge of the coverage of the (victim) facility and the ground transmitting station of the (interfering) facility as shown in Figure H-17.

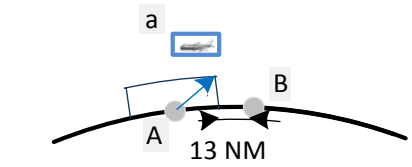


Figure H-17 Adjacent frequency separation between broadcast services

In this situation, the designated operational coverage of both broadcast services may overlap; the minimum requirement is that each of the ground transmitters is outside the designated operational

coverage (or rather the designated operational range) of the other facility with a distance of at least 13 NM as shown in Figure H-18

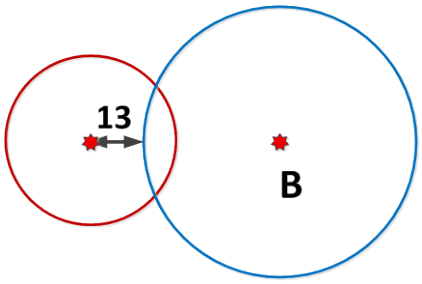


Figure H-18 Minimum separation distance between broadcast services operating on adjacent frequencies

The interference contour for each of the broadcast service is a circle with a radius of 13 NM from the interfering ground transmitter as shown in Figure H-19. If figure H-19 the shaded are is where harmful interference can be expected.

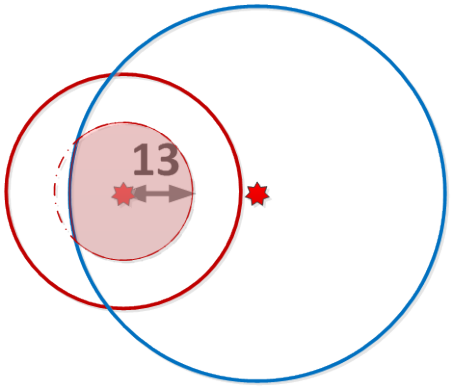


Figure H-19 Interference contour/area when the minimum separation distance requirements between broadcast services operating on adjacent frequencies are not satisfied.

5.2.2 One of the facilities provides an aeronautical broadcast service and the other facility provides air/ground communications.

The minimum separation distance to prevent interference from the facility providing air/ground communication service is 10 NM *between the designated operational coverage of each facility*, as described in §5.1.

5.2.2.1 For circular air/ground communication services, the minimum adjacent separation distance is **R_A+10+R_B NM** measured from the location (center) of the respective DOC's (to protect the broadcast service from harmful interference). The minimum separation distance in this case to protect the air/ground communication service from harmful interference from the broadcast service is **R_B+13 NM**.

R_A and R_B are the designated operational range for each circular service.

5.2.2.2 For facilities providing air/ground communication services in a specified area (ACC, FIS), the minimum separation distance to protect the broadcast service from harmful interference is **R_X+10** NM, where R_X is the designated operational range of the facility providing the broadcast service.

Facility A	Facility B	Interference contour Facility A is interferer and facility B is victim	Interference contour Facility B is interferer and facility A is victim	Minimum separation distance between facilities A and B
Circ A/G	Circ A/G	**R_A+10** From ground station A	**R_B+10** From ground station B	**R_A+10+R_B** Between ground stations
Circ A/G	Area A/G	**R_A+10** From ground station A	**10** From closest point of area service B	**R_A+10** Between ground station A and area service B
Area A/G	Circ A/G	**10** From closest point of area service A	**R_B+10** From ground station B	**R_B+10** Between ground station B and area service A
Area A/G	Area A/G	**10** From closest point of area service A	**10** From closest point of area service B	**10** Between closest points of area services A and B
Circ BC	Circ A/G	**13** From ground station A	**R_B+10+R_A** From ground station B	**R_A+10+R_B** Between ground stations
Circ A/G	Circ BC	**R_A+10+R_B** From ground station A	**13** From ground station B	**R_A+10+R_B** Between ground stations
Circ BC	Area A/G	**13** From ground station A	**R_A+10** From closest point of area service B	**R_A+10** Between ground station A and area service B
Area A/G	Circ BC	**R_B+10** From closest point of area service A	**13** From ground station B	**R_B+10** Between ground station B and area service A
Circ BC	Circ BC	**13** From ground station A	**13** From ground station B	**(Max) R_A+13 or R_B+13** Between ground station A and B

Table H-1 Calculation of minimum separation distances and interference contours for adjacent frequency facilities (25 kHz; distances in NM)

6. Unprotected services

6.1 In a number of cases, frequency assignments have been made for the implementation of services that do not require protection. One such example is aeronautical operational control (AOC) where the coordination of frequency assignments is based on the traffic loading on a particular frequency and shared use of AOC frequencies is common practice. Other examples are frequencies in use for specific non-safety related applications such as for recreational flying (gliders, balloons) and other un-specified uses.

Such unprotected services are identified in the COM list as U-0/0 (where no DOC is specified) or U-40/50 indicating that the unprotected frequency assignment is used in an area of 40 NM around the ground station and up to a flight level of 5000 ft.

6.2 Frequency assignments that are in use as an un-protected service do not require protection from harmful interference. When the frequencies are also used for aeronautical services that do require protection from harmful interference, an assessment is necessary of the potential interference that can be caused by the “unprotected” service into the “protected” service. In principle, interference *between* “unprotected” services does not require to be assessed.

6.3 In frequency finder in all cases and assessment is made of the potential interference between each frequency assignment in operation (or planned) for all services. For all unprotected services for which no DOC has been specified (e.g. U-0/0 which refers to a designated operational range of 0 NM and a designated operational height of 0 ft.) a DOC of U-50/100 has been introduced. This is an arbitrary value and requires further considerations by the relevant Regions. In cases where the frequency has been implemented to support aeronautical operational control, a DOC of U-100/250 has been assumed (100 NM, 25000 ft.).
Note: On a Regional or individual basis, a different DOC can be entered in the frequency lists. Regional consideration of DOC for AOC is recommended.
In many cases in the EUR database frequency assignments have been entered without identifying a DOC. In these cases, until further guidance is received, these frequency assignments are considered with a DOC of 100/450.

3.1.3 Aerodrome Surface (AS) communications (which assume that the aircraft is on the ground while communicating) require a co-frequency separation of at least 25 NM. This has been simulated in Frequency Finder by assuming a DOC of 5NM/100ft. This DOC is also used in cases where a frequency for aerodrome surface communications is shared with a frequency assignment in use for aircraft in flight.

Note: The Handbook, Volume II contains additional guidance material on the assigning and use of frequencies for AS communications.

Station A	Station B	Interference contour station A is interferer and station B is victim	Interference contour station B is interferer and station A is victim	Minimum separation distance between facilities A and B
Circ A/G	Circ A/G	**$R_A+R_{HA}+R_{HB}$** From ground station A **$Range#1CIRC+ $Range#2AREA**	**$R_B+R_{HB}+R_{HA}$** From ground station B **$Range#2CIRC+ $Range#1AREA**	**$R_A+R_{HA}+R_{HB}+R_B$** Between ground stations **$Range#1CIRC+ $Range#2CIRC**
Circ A/G	Area A/G	**$R_A+R_{HA}+R_{HB}$** From ground station A **$Range#1CIRC+ $Range#2AREA**	**$R_{HB}+R_{HA}$** From closest point of area service B **$Range#2AREA+ $Range#1AREA**	**$R_A+R_{HA}+R_{HB}$** Between ground station A and area service B **$Range#1CIRC+ $Range#2AREA**
Area A/G	Circ A/G	**$R_{HB}+R_{HA}$** From closest point of area service A **$Range#2AREA+ $Range#1AREA**	**$R_{HA}+R_{HB}+R_B$** From ground station B **$Range#1AREA+ $Range#2CIRC**	**$R_B+R_{HB}+R_{HA}$** Between ground station B and area service A **$Range#2CIRC+ $Range#1AREA**
Area A/G	Area A/G	**$R_{HA}+R_{HB}$** From closest point of area service A **$Range#1AREA+ $Range#2AREA**	**$R_{HB}+R_{HA}$** From closest point of area service B **$Range#2AREA+ $Range#1AREA**	**$R_{HA}+R_{HB}$** Between closest points of area services A and B **$Range#1AREA+ $Range#2AREA**
Circ BC	Circ A/G	**R_{HB}+15** From ground station A **#Range#2AREA+15**	**$R_B+R_{HB}+R_{HA}$** From ground station B **$Range#2CIRC+ $Range#1AREA**	**$R_A+R_{HA}+R_{HB}+R_B$** Between ground stations **$Range#1CIRC+ $Range#2CIRC**
Circ A/G	Circ BC	**$R_A+R_{HA}+R_{HB}$** From ground station A **$Range#1CIRC+ $Range#2AREA**	**R_{HA}+15** From ground station B **$Range#1AREA+15**	**$R_A+R_{HA}+R_{HB}+R_B$** Between ground stations **$Range#1CIRC+ $Range#2CIRC**
Circ BC	Area A/G	**R_{HB}+15** From ground station A **#Range#2AREA+15**	**$R_{HB}+R_{HA}$** From closest point of area service B **$Range#2AREA+ $Range#1AREA**	**$R_A+R_{HA}+R_{HB}$** Between ground station A and area service B **$Range#1CIRC+ $Range#2AREA**
Area A/G	Circ BC	**$R_{HB}+R_{HA}$** From closest point of area service A **$Range#1AREA+ $Range#2AREA**	**R_{HA}+15** From ground station B **$Range#1AREA+15**	**$R_B+R_{HB}+R_{HA}$** Between ground station B and area service A **$Range#2CIRC+ $Range#1AREA**
Circ BC	Circ BC	**R_{HB}+15** From ground station A **#Range#2AREA+15**	**R_{HA}+15** From ground station B **$Range#1AREA+15**	**(Max) R_A+R_{HA}+15 or R_B+R_{HB}+15** Between ground station A and B **Max $Range#1BC or Range#2BC**