

# Intermod



# Table of Contents

Foreword	1
<b>Part I General Usage</b>	<b>3</b>
1 Creating a New Study .....	3
<b>Part II Intermod Site Study</b>	<b>5</b>
1 Study Configuration .....	5
2 Results Screen .....	7
<b>Part III Intermod Map Study</b>	<b>10</b>
1 Study Configuration .....	10
2 Map Study Results .....	12
3 Methodology .....	13
<b>Index</b>	<b>15</b>

# Foreword

Intermod is designed to perform standard intermodulation analysis at a specific site and an advanced study to identify possible intermodulation issues within a station's coverage area.

**General Usage**

**Part**

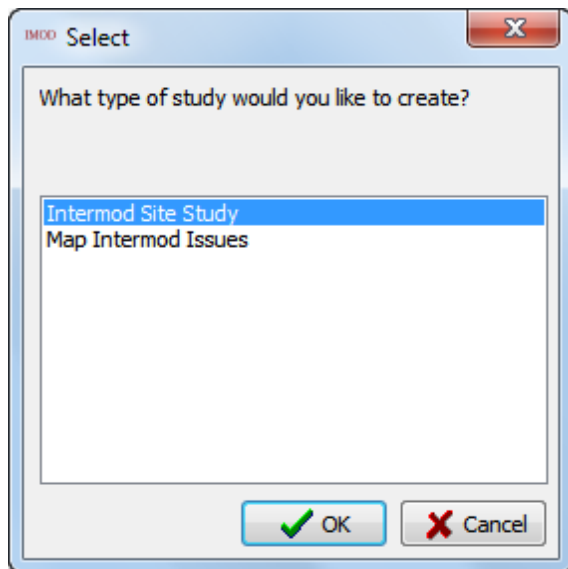
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# 1 General Usage

## 1.1 Creating a New Study

Choose “File” ? “New” in the menu system to start a new study. A window will appear asking what type of study to create:



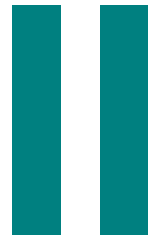
**Intermod Site Study** – Use this to determine the intermodulation products for a set of transmitters that are in the same location.

**Map Intermod Issues** – Use this to find possible intermodulation issues that occur within a transmitters coverage area.

# Intermod Site Study

**Part**

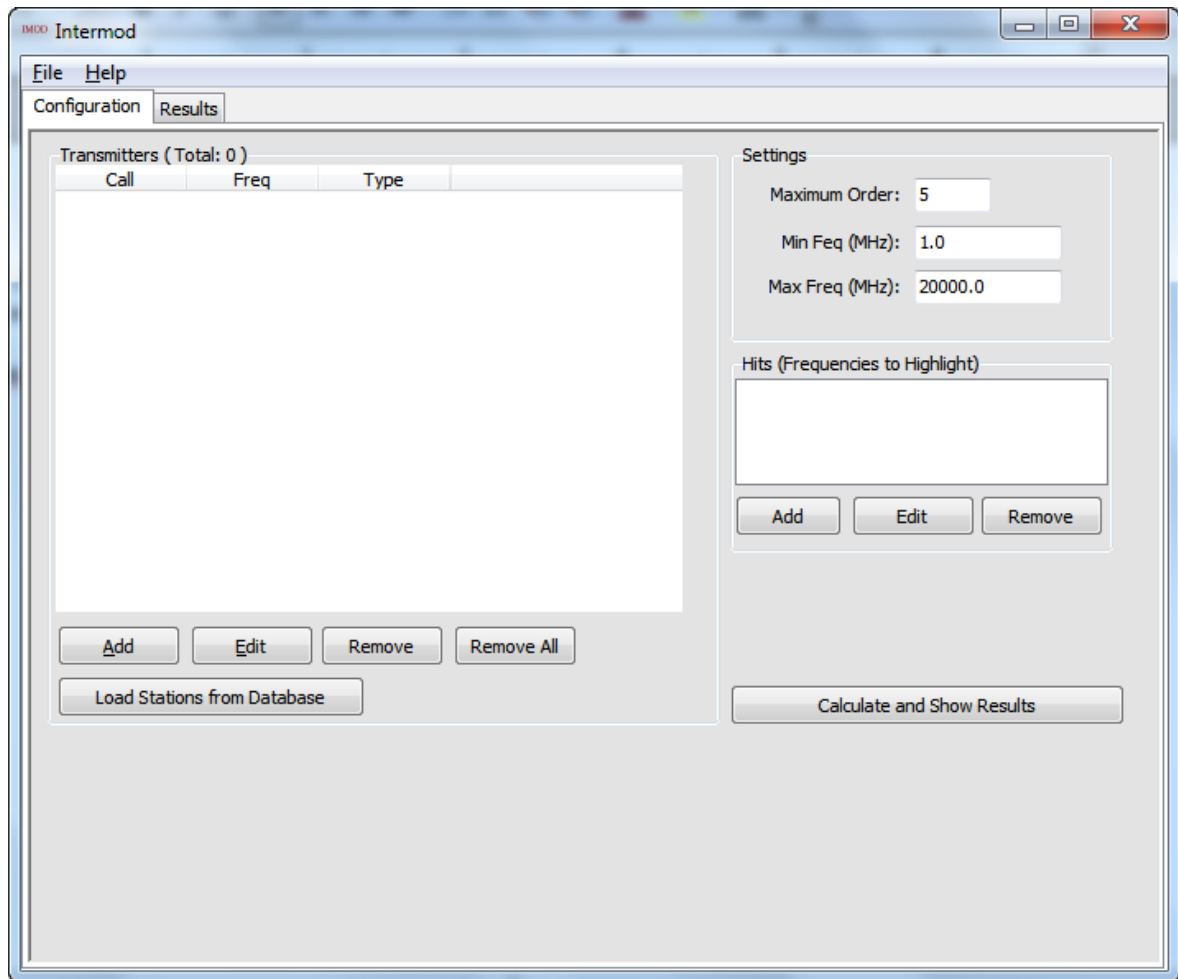
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## 2 Intermod Site Study

### 2.1 Study Configuration

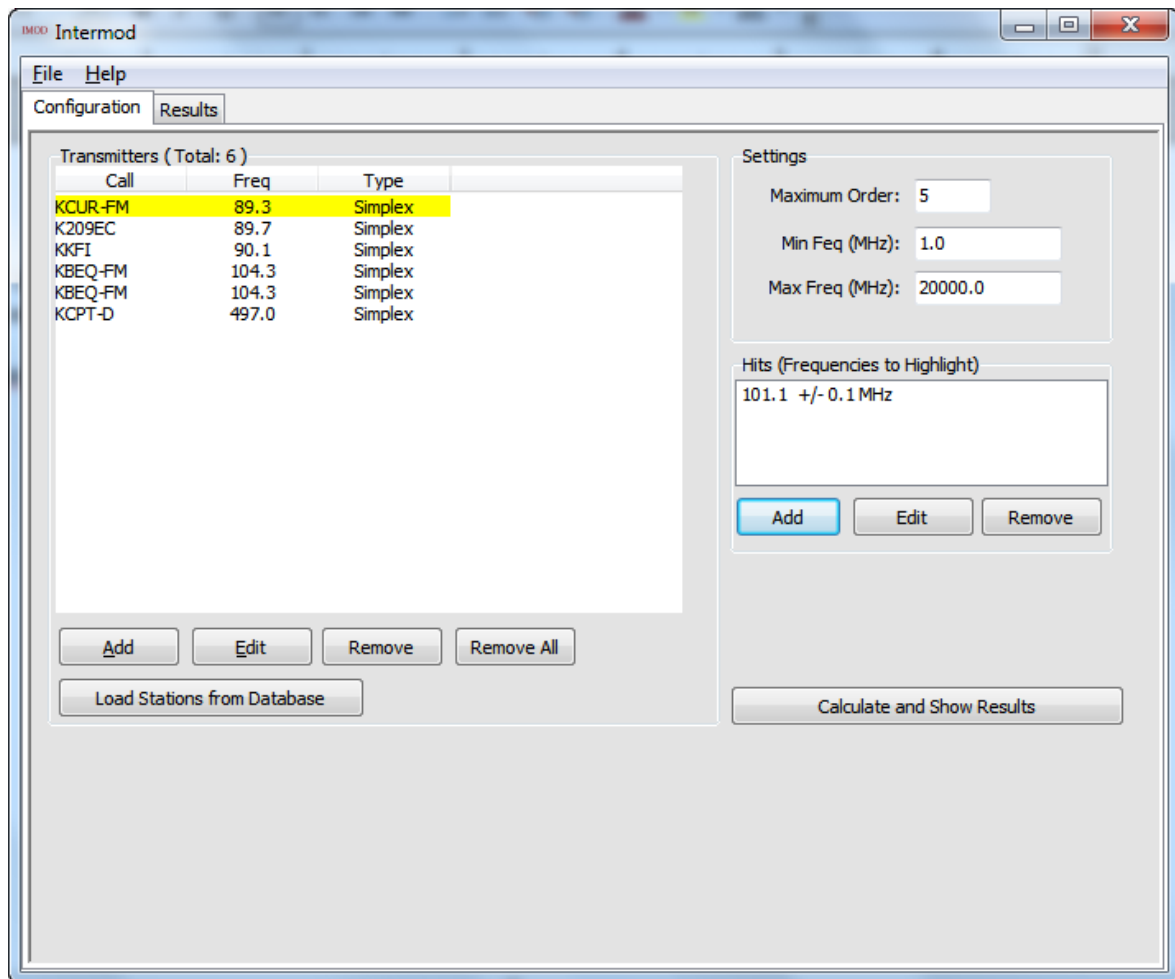
When starting an intermod site study from scratch the configuration tab for the study is shown.



Generally, the user would begin by adding transmitters at the location under study to the transmitter list. A single transmitter can be added using the "Add" button (from the transmitter editor, single transmitters can be loaded from the FCC FM and TV database). The "Load Stations from Database" can be used to load multiple stations near a latitude/longitude point at once from the database. The point used by default is the location of the first transmitter in the list, therefore one effective pattern of use would be to load the first transmitter manually and then load the rest using the "Load Stations from Database" button.

The "Settings" section contains some general settings used for calculation. Use the "Hits" section to define any frequency regions that you would like to have highlighted as potential victims of intermodulation interference (this portion is optional).

This sample shows a configured study:

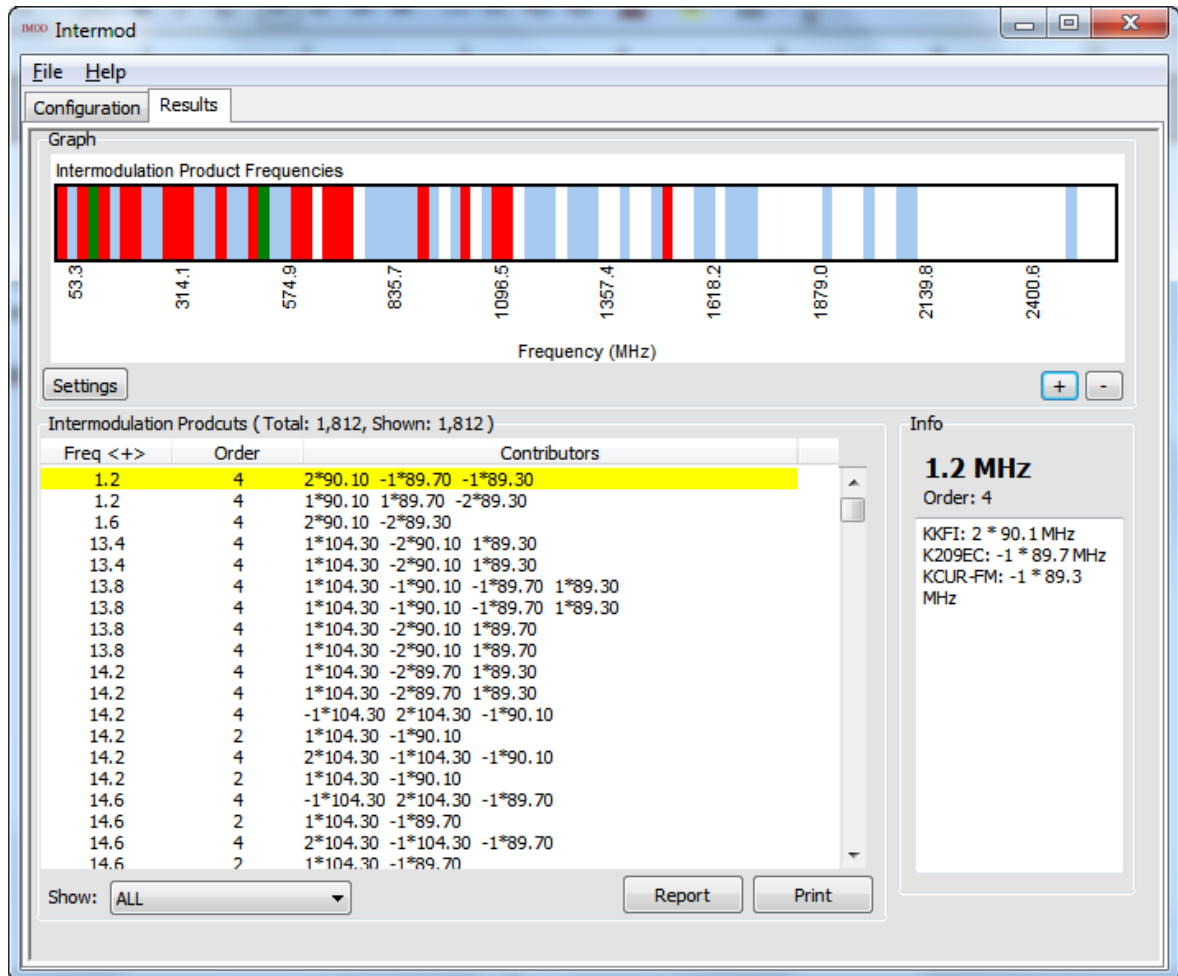


Once the study parameters are defined, click the “Calculate and Show Results” button to run the study and display the results tab. Note that once the results have been calculated, changes to the study configuration can be made by going back to the “Configuration” tab.



## 2.2 Results Screen

After a study has been configured and products have been calculated the "Results" tab will display the resulting frequencies.

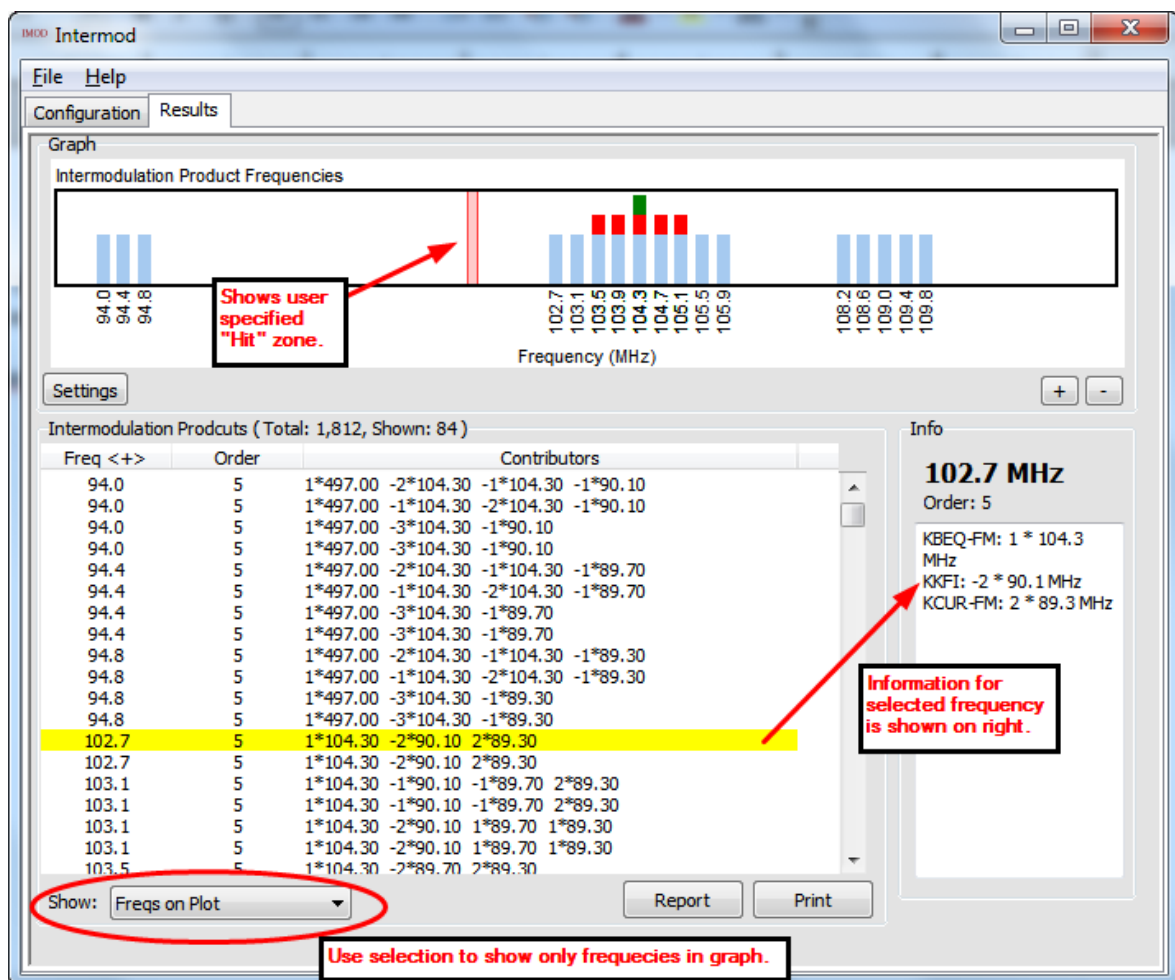


The frequency of any intermodulation product that occurs in any of the "Hit" zones that have been identified by the user will be highlighted in red.

The "+" and "-" buttons at the top can be used to scale the display (to show more or less frequencies in the graph). The "Settings" button also allows the user to configure the display. The "Info" column shows information related to the frequency line selected in the table on the left.

As the display is zoomed and less frequencies are shown the heights of the bars will change so that the smaller order products will be shown with larger bars.

Here is this study that has been configured to show the intermodulation products near the “hit” zone specified at 101.1 MHz for this study:

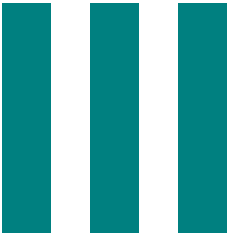


The frequencies shown in blue indicate products of greater than third order. The ones displayed in red indicate second and third order products. The frequencies shown in green indicate a fundamental frequency of one of the transmitters included in the study.

The “Report” and “Print” button can be used to generate a text report and print out of the intermodulation products shown in the table.

**Intermod Map Study**

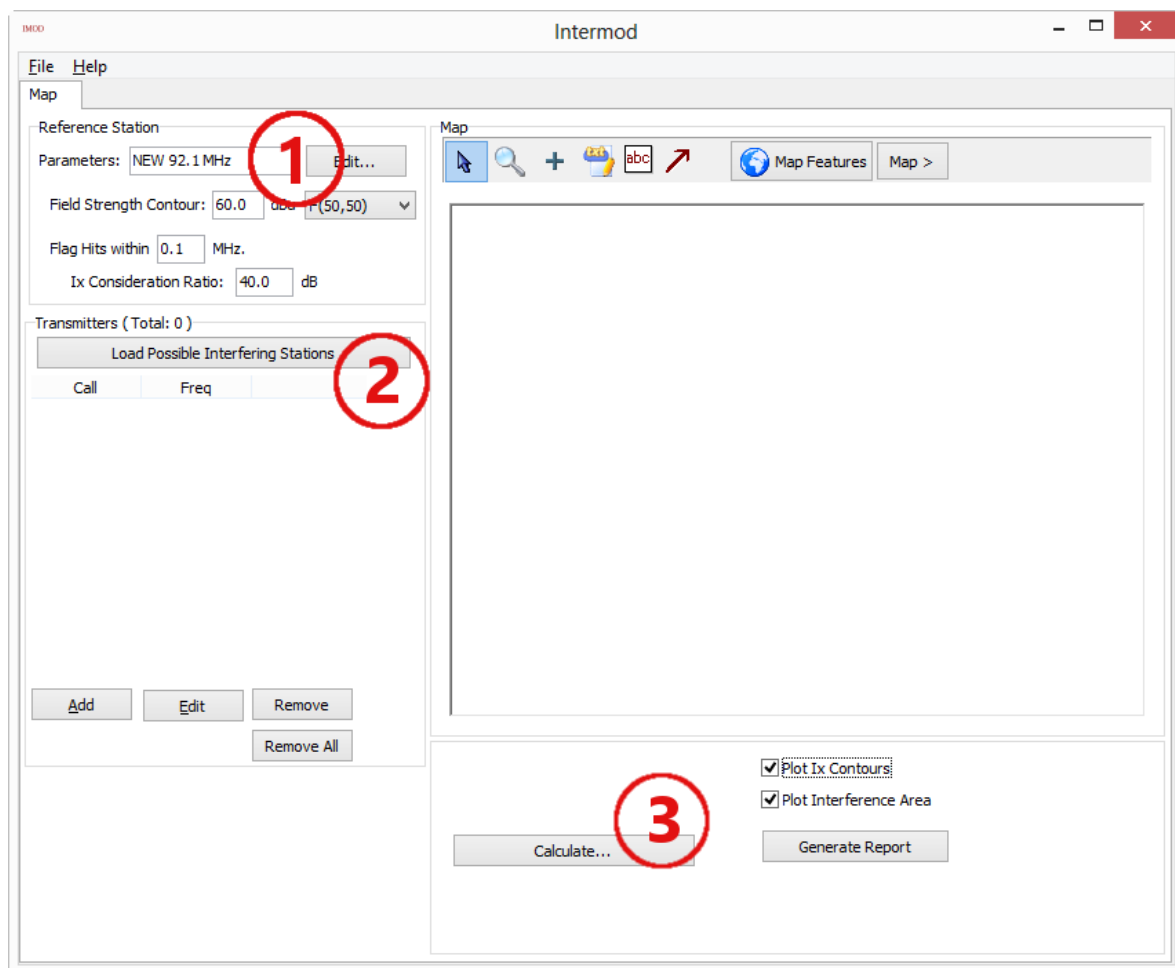
**Part**



## 3 Intermod Map Study

### 3.1 Study Configuration

This study type can be used to determine where intermodulation issues might exist within a transmitter's coverage zone. There are typically three steps that need to be performed to configure this study. When creating a new study, the following window is shown:



The user must complete three steps to perform the study:

#### Step 1

Configure your reference station and study settings. Use the "Edit" button to enter or load the reference station's parameters. Other settings:

Field Strength Contour – Defines the area in which intermod calculations will be performed.

Flag Hits Within – Specifies a +/- frequency range from the reference stations frequency at which intermodulations products will be flagged (outside of this range products will be ignored).

Ix Consideration Ratio – Defines the field strength level of interfering stations to be considered for possible harmful intermodulation products. Generally intermodulation products are only strong

enough to be destructive at areas near the contributing transmitters where their primary fields are intense. Only points where the interfering signal levels are greater than the reference station's signal level plus the "Ix Consideration Ratio" will be considered for interference.

**Step 2**

Indicate which transmitters are to be considered for causing interference to the reference station. Use the "Load Possible Interfering Stations" to automatically load transmitters from the FCC databases. Note that at the completion of this step, the program will ask if you wish to perform 'step 3' (calculation) automatically.

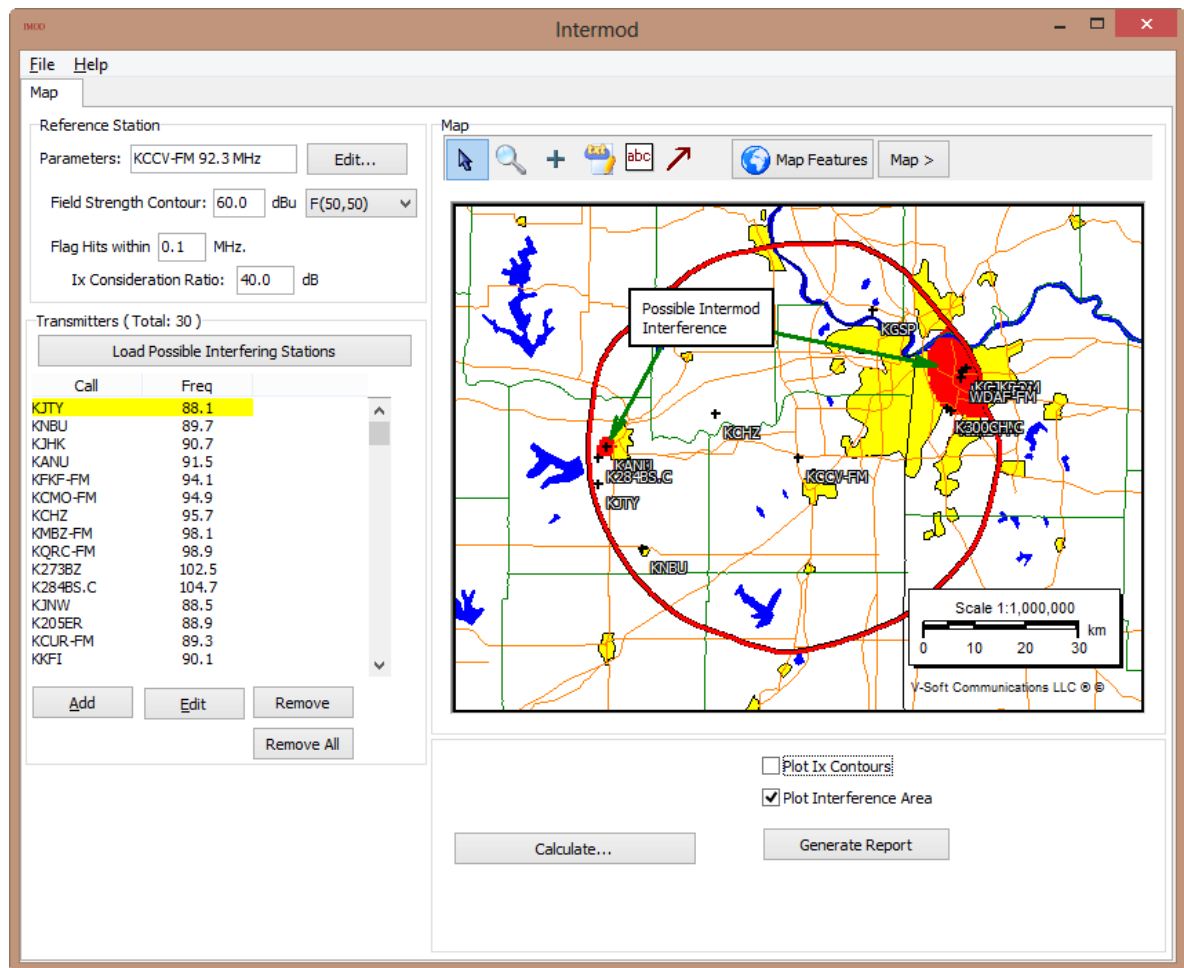
**Step 3**

Click the "Calculate" button. This will cause the possible intermodulation products to be found and issues to be displayed on the map. This calculation can take a while depending on how many stations are under consideration have common areas of high field strength.

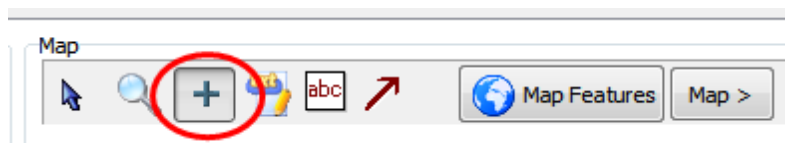
NOTE: After calculations have been performed, changes can be made to the reference station, projects settings, or interfering transmitter list, however, the end results will not be recalculated until the "Calculate" button is clicked again.

## 3.2 Map Study Results

After the "Calculate" button has been clicked and calculation has completed, the map will be redrawn to show areas where intermodulation interference may exist.



Once calculations have been completed the map will indicate areas of possible intermodulation interference in red. Click the "Generate Report" button to generate a report that shows the intermodulation products that land near the reference frequency for points where interference is shown. To generate a report for a specific area on the map, select the cross hair tool:



and then click on an interference point on the map to generate a report showing the transmitters involved.

### 3.3 Methodology

#### Calculation of Possible Interference Area

The map based intermodulation study identifies areas where interference could be an issue within the overall coverage zone of a reference station. To do this the program identifies locations where stations have high field strengths and form an intermodulation relationship that falls on or near the frequency of the reference station.

Simple Two Station Example:

Within the coverage area of an FM station that operates on 105.3 MHz there are two stations that are on unrelated frequencies:

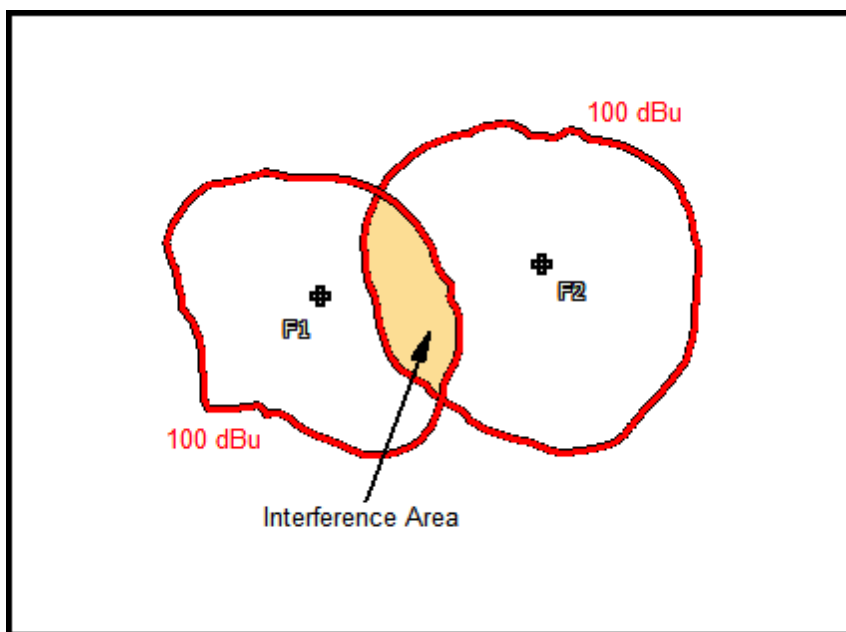
F1 = 97.3 MHz

F2 = 89.3 MHz

In this case the second harmonic of the first station combines with the fundamental frequency of the second:

$$F = 2 * F1 - F2 = 2 * 97.3 \text{ MHz} - 89.3 \text{ MHz} = 105.3 \text{ MHz}$$

In areas where the field strength of both stations are strong (compared to the reference station), interference may occur. The program considers a user defined ratio (identified as the "Ix Consideration Ratio") to determine where signals are strong enough to be considered. A typical value for this ratio is 40 dB, meaning that each signal in the interfering mix must be at least 40 dB higher than the reference station's field strength. For locations near the edge of the 60 dBu coverage area, this means that the field strengths of interfering stations must be more than 100 dBu (40 dB higher) to be considered. In this case, to determine the potential interference area the intersection of the 100 dBu field strength contours for each station is considered:



Some receivers will be more resistant to intermodulation interference than others. The required field signal ratio for interference can be adjusted to accommodate for this. A higher interference consideration ratio will show smaller interference areas.

When performing a map based intermod study, the program breaks down the reference station's coverage area into a grid of cells. For each cell the transmitters in the study that have a field strength level greater than the "Reference Transmitter Field Strength + Ix Consideration Ratio" level specified in the study settings are identified. An intermod analysis using those transmitters is performed and if they create a third order intermodulation product that is on the same frequency as the reference station the cell is highlighted for possible interference.

Note: At this time only third order intermodulation products are considered in the map based study.



# Index

## - C -

Calculation Methods 13  
Classic Intermod Study 5  
Configuration (Map Study) 10  
Configuration Tab 5  
Creating a New Study 3  
Cross Hair Tool 12

## - G -

Graph 7

## - I -

Intermodulation Calculation (Map) 13

## - M -

Map Study Configuration 10  
Map Study Results 12  
Methodology 13

## - N -

New Study 3

## - P -

Products Graph/Table 7

## - R -

Report Intermod Interference 12  
Results (Map Study) 12  
Results Tab 7

## - S -

Standard Point Study 5  
Study Settings (Standard) 5