

Frequency Manager + Scanner

User's Guide

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Introduction

The **FMSuite Frequency Manager + Scanner** (called FM in the rest of this guide) is a free plugin designed for use within the SDR# software application. It delivers a full-featured frequency management tool permitting you to edit and browse frequencies, and a scanner to scan ranges of frequencies or groups of frequencies that you define. Written in C#, it is designed for performance and flexibility.

System Requirements

Basically, if you can run SDR#, you can use the Frequency Manager. As with any software, the more capable your hardware the better the software will run.

- **Hard Disk:** The FMSuite software requires about 104MB; the frequency database size is dependent on the number of records. 1000 records will fit in a 268KB database.
- **SDR#:** Version 1893 or newer.

Important Note

SDR# is an application created by other people and I am not involved in it. I have no control over changes made to SDR#. I am completely at their mercy as to how their changes affect FM. They are under no obligation to inform me of changes; I won't know if their changes will break my plugins until the plugins are run with the new version of SDR# and you tell me there is a problem. As a result, there will be a period after they make a breaking change in which my plugins may not work. Please be assured I will make any necessary changes, and release updates, as soon as practical after SDR# is changed and I have identified the issues.

Using the Frequency Manager

The Frequency Manager permits you to automatically record frequencies to a database as they are found, or to hand-enter and edit frequencies. It provides 10 presets that you can define for different frequencies, editing tools for the various dropdown lists it uses, and a very flexible database browser that you can use to find, edit, and send to the radio the frequencies you are interested in.

After your first startup of SDR# with the plugin installed, and before you start monitoring, is a good time to begin customizing Groups, Services, Protocols, and some of the text that goes into dropdown lists or in default texts. See the sections of this document on Groups, Services, Protocols, and Preferences for more information.

Because of the way FM works, you may be required to run SDR# as Administrator.

The Frequency Manager Panel

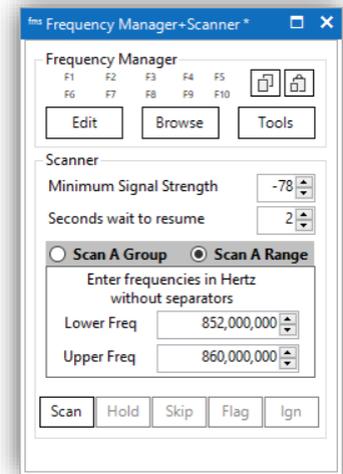
The FM panel contains two groups of controls.

- The Frequency Manager group contains the buttons that open FM editing windows and tune the radio to preset frequencies.
- The Scanner group contains the controls for the scanner. These allow you to select a scan type, start/stop/pause the scanner, skip a frequency that makes the scanner stuck, flag a frequency for later attention, and tell the scanner to ignore a frequency when scanning. The Scanner group will be described fully later in this document.

Functions in the Frequency Manager Group

Presets

At the top of the panel are two rows of buttons labeled “F1” through “F10”. Right-clicking a button will display a menu that allows you to assign the current radio frequency to that preset, or to remove the stored frequency from that preset. To recall a preset and tune the radio to its frequency, simply click that button. Each button also displays a tool-tip that shows the frequency and description stored in that preset. You may also press the keyboard function keys F1 through F10 as long as the SDR# window is the active window in SDR#.



Using a Preset will put SDR# into Free Tuning mode in an attempt to honor your Preset’s Frequency and Center Frequency separation when they are different.

Copy

To the right of the Presets is a button that, when clicked, will copy the current frequency to the clipboard for use in documents or in other applications. If the copy is successful a small tooltip stating “Copied OK” will be briefly displayed.

Paste

This button located to the right of the Copy button allows you to paste a frequency from the clipboard into the radio. It will attempt to convert what’s on the clipboard to a compatible number. If the clipboard contents are not compatible, nothing will happen.

You may also tell the plugin to continuously monitor the clipboard for text that could be interpreted as a frequency; see the section on the Preferences window for how to enable that feature.

Edit

The Edit button displays or hides the Edit window. The full description of the Edit window is given after this section.

Browse

The Browse button displays or hides the Browse window, which displays a grid of the frequencies in your FM database. The Browse window can be displayed and be used at the same time as other plugin features. Details of the Browse window are described later in this document.

Tools

This button opens a menu that allows you to select Edit Groups, Edit Protocols, Edit Services, or Edit Preferences. The menu choice you take will open the editor for that set of data. These modules are described later in this document.

Info

This “hidden” function displays information about FM: the version, the date and time it was last modified, the name of the current frequency database, the database version number, and a copyright notice. Access this function by clicking your mouse anywhere in the FM plugin and then pressing the three keys *Ctrl + Alt + I* simultaneously. In a few seconds a popup will display the application information.

Round Up / Round Down

When manually tuning frequencies, especially on shortwave and lower frequencies, you might not always click *exactly* on the center of the frequency. By pressing *Ctrl + Alt + PgUp* or *Ctrl + Alt + PgDn* you can tune the radio to the nearest step size in order to center the radio.

The Edit Window

Editing Single Records

Clicking the Edit button on the FM panel displays the Edit window. The Edit window allows you to add and update frequency records. You can also copy the information from an existing record to create a new record.

The fields for each frequency are:

- Frequency
- Center Frequency
- I've Heard This
- Description
- Callsign
- Mode (NFM, AM, etc.)
- Frequency Shift
- Filter Type
- Filter Order
- Filter Bandwidth
- Squelch
- Squelch Enabled
- CW Shift
- Step Size
- Protocol (Voice, P25, POCSAG, etc.)
- Service (Business, EMS, Transportation, Federal, Law Tactical, etc.)
- Ignore this frequency when scanning
- Frequency is flagged for attention
- Show this frequency on the spectrum display
- Groups to which the frequency is assigned
- Notes
- City
- Latitude
- Azimuth
- Start Time
- Days
- Power
- Country
- Longitude
- Target
- Stop Time
- Language
- Last Update date

The Edit window contains two tabs: Basic and Extended.

- The Basic Info button contains the most commonly used fields – Frequencies, Mode, Shift, Notes, etc.
- The Extended button contains info about the transmitter location and to whom it is transmitting, along with City and Country, Days it transmits, Start and Stop times, Target region of the world, etc.

The Edit window has simple error checking on the Basic Info tab to ensure that you are entering data appropriate to the field. If you enter inappropriate data, a red circle with an exclamation mark  appears next to the field. If you let your mouse pointer hover over the red circle it will display a message about the error. You cannot move to another field until the error is corrected, and you cannot save a record when there are errors. Not all fields require “correct” input; for example, you can enter any text in Description or even leave it blank. However, the two frequency fields must not have number separators in them; the Edit dialog will add them when necessary. Every numeric field except Shift requires a value in a range compatible with SDR#.

The checkbox “Show this frequency on the spectrum display” controls whether or not the Description of a frequency is displayed on the spectrum with a marker for its frequency. See the section “Database Frequency Spectrum Display” for more information.

The Extended Info button contains fields that are more free-form and that are designed to contain data imported from various internet sources; since not all these sources format the same data the same way, most of the fields have no error checking. The exceptions to this are the Start Time and Stop Time fields, which require times in 24-hour format, and the Power field which requires whole numbers (no digit separators). You decide whether to express power in Watts, Kilowatts, or Megawatts but only numbers can be used in the Power field.

Clicking the Add button will create a record. Clicking the Update button will update an existing record, and clicking the Cancel button will exit without saving any data.

If the Edit window was launched from the FM panel, and if you are editing a frequency that is not yet in the database, the Update button will be disabled. If the frequency is already in the database both the Update button and the Add button will be enabled. This permits you to change the current record (via Update) or create a new record (via Add) by changing the record data and clicking Add. The Edit window will not prevent you from Adding a record identical to one already in the database having the same frequency; the design assumption is that there will be cases where you will find two or more stations on the same frequency.

fms Edit a Frequency

Frequency Center I've heard this

Description Callsign

Basic Info **Extended Info**

Mode CW Shift

Shift Enabled Step Size

Filter Type Protocol

Filter Order Service

Filter BW Ignore when scanning

Squelch Enabled Flagged

Show on spectrum display

Groups

- LW
- MW
- Shortwave

Notes

fms Edit a Frequency

Frequency Center I've heard this

Description Callsign

Basic Info Extended Info

City Country

Latitude Longitude

Azimuth Target

Start Time Stop Time

Days Language

Power Last Update 8/2/2022

Some notes about the fields in the Edit window:

- “I’ve heard this” indicates whether or not the frequency has been monitored. If you are Adding or Updating a frequency you may optionally check this box. When a frequency is “heard” by the scanner, and Preference > Scan Rules > “Update a frequency’s Date when monitored” is checked, then the “I’ve heard this” checkbox is checked automatically. This box will also get checked when you click the Flag button on the scanner.
- Description and Notes are free-form text and support up to 32,767 characters.
- The Notes field supports multiple lines of text; just press the Enter key to start a new line.
- The Protocol field is prepopulated with over 140 popular transmission types from which to choose, including those commonly used in HF through UHF frequencies. See the Protocols Window section in this document to get info on how to edit this data. See the Appendix for a list of the default protocols provided. Protocols that you add using the Protocols editing window will be added to that list.

- The Service field is prepopulated with over 30 popular services from which to choose, broadly based on the services defined by the U.S. Federal Communications Commission. See the Services Window section in this document to get info on how to edit this data. See the Appendix for a list of the default services provided. Services that you add using the Services editing window will be added to that list.
- Mode and Filter Type provide the same options as SDR#. If you have a record in an older (and auto-upgraded) database with “Blackman-Harris” as the Filter Type it will be treated as “Blackman-Harris 4”.
- The Groups field will be blank until you create groups, at which point it will be populated with a list of checkboxes that you can use to add or remove groups for the frequency. You may select no groups for a frequency or as many as you please; do what is meaningful to you.

When you close the Edit window, its position on the screen is remembered for the next time you use it.

Bulk Editing of Frequencies

You may edit multiple frequencies at once when you select multiple records in the Browse window and click its Edit button or the its context menu Edit item. An example of this might be when you want to change the Service type for a number of frequencies simultaneously.

Caution

You can ruin quite a lot of frequency records at one time if you aren't careful with the bulk editing feature. **Anything you change here will be changed in all the selected records.** Be sure of your changes before you commit them by clicking the Update button.

When bulk editing, the Edit window behaves a little differently. When all the frequencies being edited have the same value in a field, the field will display the common value. If the frequencies have *different* values in a field, the field will display as a blank. As an example, consider this Edit window screenshot.

In this illustration the selected records all share the same Frequency, Center, Mode, Protocol, Service, Filter Order, CW Shift, Squelch, and Squelch Enabled.

However, they have different Description, Callsign, Heard, Notes, Flagged, and Ignored values, so those text boxes and dropdowns are blank.

In this dialog all checkboxes (Ignore, Shift Enabled, etc.) are what is called “Three-State” checkboxes – meaning they can be Checked, Unchecked, or “Indeterminate” meaning unknown. When some of the selected frequencies have a checkbox checked and others don’t, the result is Indeterminate. How this state is displayed depends on your version of Windows. On my Windows 10 computer these are shown as a checkbox filled with a solid color. On some other Windows operating systems, they are shown with a ‘ghosted’ checkmark in the box.

Whatever you change in this dialog will be changed in all the selected frequencies – the original values will be permanently overwritten, except for Groups which are a special circumstance. When editing multiple frequencies all the Group selections are shown as unchecked regardless of what groups are assigned to those frequencies. If you check one or more Groups when bulk editing, the Group(s) will be added to those of each of the frequencies rather than replacing them. So, if one of the edited frequencies already has the Education Group, and you select the Transportation Group in the bulk edit, that frequency will end up in both Education and Transportation Groups.

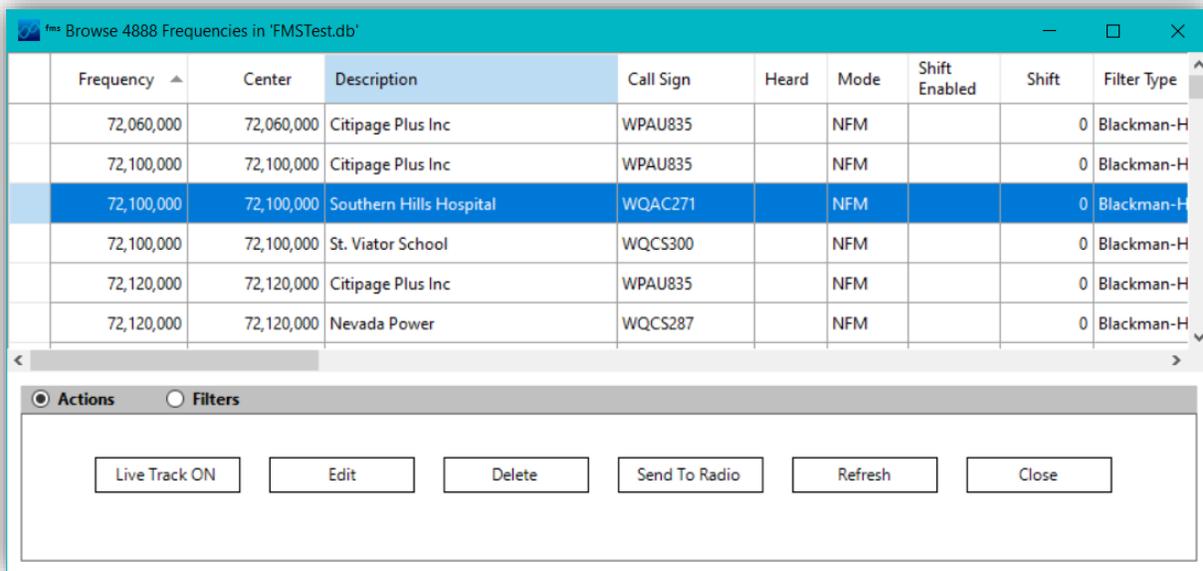
Bulk Edits also change the Date field of each record to the current Date and Time if “Allow Bulk Edits to change Last Update field” is check-marked in the Frequency Manager tab of the Preferences window.

To abandon any bulk-edit changes, click Cancel. To apply bulk-edit changes, click Update. You will be prompted to confirm that you want to change multiple records.

When bulk editing, the same data validations apply as when editing a single record.

The Browse Window

This window displays a grid of all frequencies in the FM database. All of the data entered for a Frequency is displayed plus the date the record was added or last updated and the Source of the data.



- The grid scrolls vertically and horizontally so you can access the information. You may also change the size of the window, which will adjust the size of the grid accordingly.
- You may sort the contents of a column in ascending or descending order by clicking the column’s header. The default sort order is by Frequency ascending.
- You can reorder the columns. To move a column left or right in the grid, left-click and hold on its header text, pause 3-5 seconds, and then drag the header to a divider between two other columns. The target divider will change color to help you see the drop point. When the column header is in the desired position, release the mouse.
- You can resize the columns by letting your mouse pointer hover over the divider line between two column headers. The mouse pointer will become a left-right pointing arrow. Left-click the divider and drag it left or right to narrow or widen the column. You may also make a column fit its contents by

double-clicking the divider. Column sizes and order are remembered for use the next time you open the Browse window.

A helpful feature of the Browse window is that it can track the frequency in SDR# “live”; when you scan to a frequency that is in your database, the Browse Window positions itself to that frequency.

Note

If you have a large database, and if the Browse window is full-screen or at least very large, you may find that the Browse window becomes sluggish especially when Live Track is on. Resize the Browse window, or disable Live Track, if you have this problem.

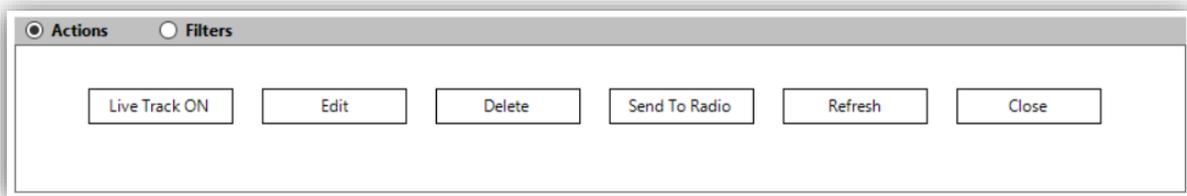
Functions in the Browse Window

The Browse window contains two tabs of controls.

Actions Button

Live Track

This button enables or disables the Live Track feature that makes the grid auto-scroll to the frequency currently being monitored. This button latches state as either pressed or released - when it is pressed the grid tracks the frequency changes of the scanner or the spectrum analyzer; when released it does not, and this makes it easier to browse or bulk edit frequencies while the scanner is running.



Hint

If you find that SDR# pauses during Browse window scrolling, or if the Browse window contents get garbled, this may be an indication of performance problems; turn off Live Track and instead use the Refresh button periodically to force the grid to reload from the database after records are added, deleted, or changed.

If you are using more than one copy of SDR# sharing the same FMSuite database, turn Live Track off to improve performance.

Edit

You may launch the Edit window from the Browse window. It behaves the same as when launched from the FM panel, with the exception that the Add and Update buttons are always enabled when editing a single frequency.

Delete

The Delete button allows you to delete a frequency or a set of selected frequencies. A confirmation popup will appear. Deleting a frequency whose data is currently set in the radio will not result in changes to the radio settings. Deleting a frequency cannot be undone.

Send to Radio

You can send the selected record to the radio using the Send to Radio button; but you can also do this by just double-clicking the selected row. The button is disabled if you have selected multiple rows in the grid. Please

note that the red line indicating the current frequency in SDR# behaves differently when using Send to Radio. When using Send to Radio, SDR# is set to Free Tuning mode and the center frequency and frequency recorded in the database are sent to the radio, which may cause SDR#'s red line to change position.

Refresh

This button tells the grid to throw away all of its data and completely reload from the database. Use of the Refresh button is always optional, but if you have Live Track turned off during a frequency range scan this can update the grid with the latest frequency data.

Close

Closes the Browse window; the window remembers its current size and position for your future convenience.

Filters Button

There are 10 fields upon which the database can be sorted. For each of these fields, click the  button at the right end of the field to remove that filter.

- **Freq/Desc** will let you enter a Frequency, text from the Description field, or text from the Notes field.
- **Group** dropdown will allow you to choose a group from those you have defined. The grid will then display only those Frequency records which are assigned to the chosen group.
- **Flagged/Ignored** dropdown lets you ignore either attribute, show only the Flagged frequencies, or show only the Ignored frequencies.
- **City, Country, Target, Language, Days, Start Time** are fields from the Extended button of the Edit window. You may enter full or partial text from the same field in the database.
- **Source** defines the source of the data. FM records the source of each record. For example, if a record is hand-entered using the Edit window, or if it was automatically entered by the scanner, the Source will be set to "FMSuite" in the database. If the record was imported from an internet database, the Source field will reflect that database, e.g., "Aoiki", "Eibi", etc.



The filters are additive; the more filters you create, the more specific the filter becomes, so you will get fewer results. To filter the list, click the Apply Filters button after entering your filter choices. To remove all of the filters at once, click the Clear Filters button.

Context Menu

Right-clicking a grid row or selected rows on the grid displays a context menu with the following options:

- **Edit:** Displays the Edit window.
- **Delete:** Displays the Delete confirmation, which will prompt you to approve deletion of the selected record(s). Upon confirmation the record(s) will be deleted.
- **Toggle Flagged & Toggle Ignored:** These choices flip the state of the Flagged and Ignored fields; not-Flagged becomes Flagged, Ignored becomes not-Ignored, etc.

The Context Menu is disabled when the scanner is running and Live Track is turned on.

The Tools Menu

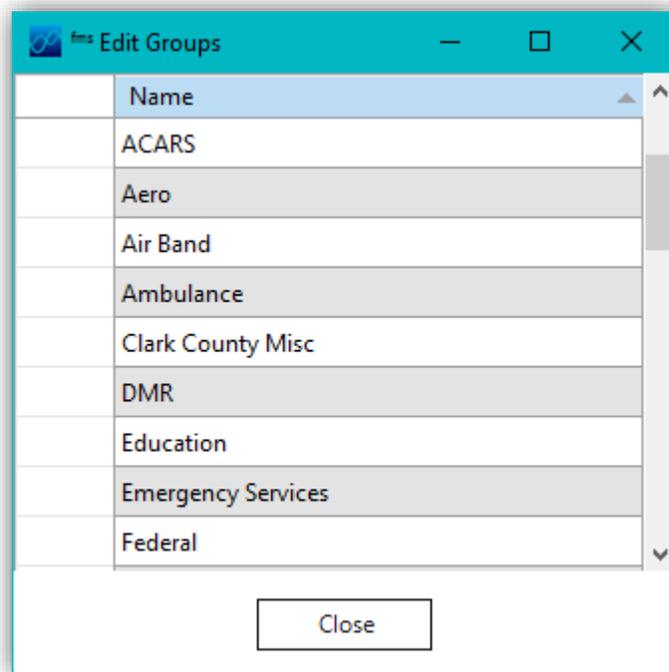
Clicking the Tools button will display a menu giving you access to some of FM's configuration data. This is broken down into the Groups list, the Protocols list, the Services lists, and your personal Preferences for how FM behaves.

The Groups Window

The Groups window lets you create and edit labels by which you can group frequencies. The Name of a Group can be anything meaningful to you; for example, in Las Vegas where I live, I have groups for Metro Police, Resorts, and County government, among others.

Adds, Edits, and Deletions of groups are automatically propagated to the Scanner's Scan Group list, and to the Browse window's Group list if the Browse window is open.

Functions in the Edit Groups Window



Add

To create an entry, select the last row of the grid (by default it is empty) and start typing. The entry will be saved automatically when you move off the row. If you need to abandon your entry before saving, press the Escape key on your keyboard.

Edit

To edit an entry, select the desired row and start typing. The entry will be saved automatically when you move off the row. If you need to abandon your change before saving, press the Escape key on your keyboard.

Delete

To delete a row, select the whole row by clicking the left end of the row and press the Delete key on your keyboard. A confirmation prompt will be displayed.

Close

This button closes the Groups window; the window remembers its current size and position for your future convenience.

The Edit Protocols Window

This window works the same way as the Groups window (see above) but displays the different transmission protocols you can assign to a frequency – like Voice, POCSAG, RTTY, etc.

The Edit Services Window

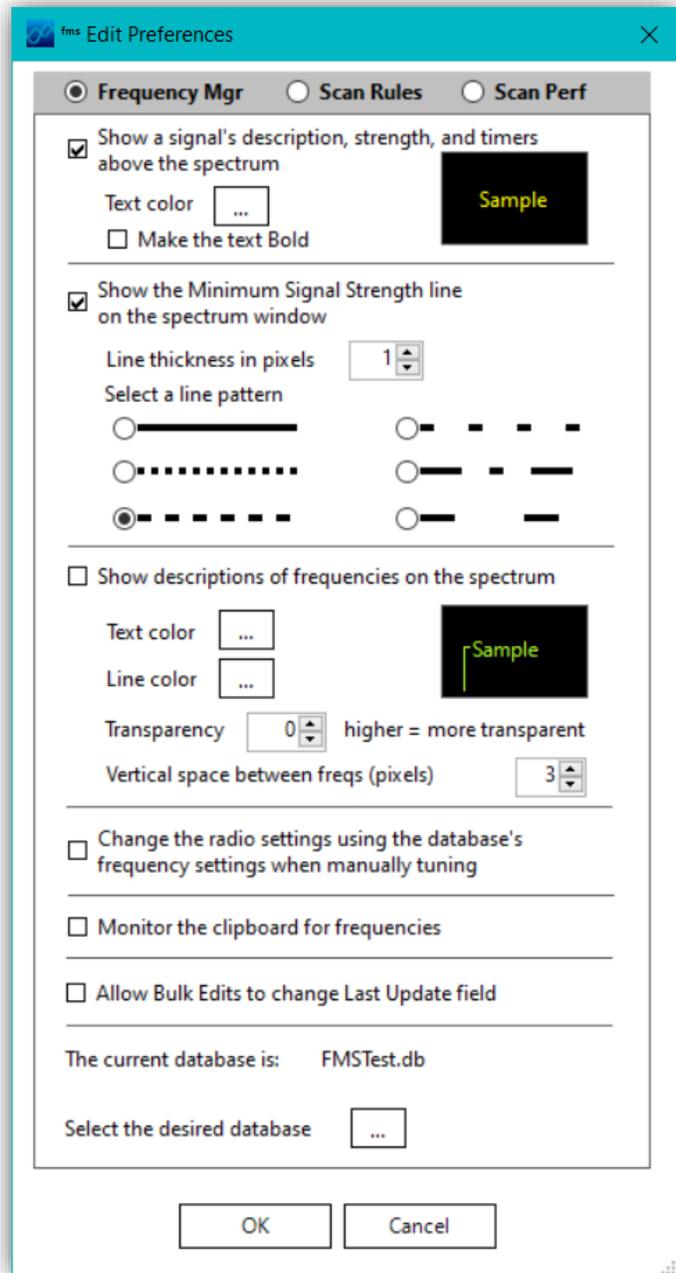
Likewise, the Services window works the same way as the Groups window (see above) but displays the different Services you can assign to a frequency – like Business, Law Dispatch, Aero, etc.

The Edit Preferences Window

This window is opened from the Tools button menu in the Frequency Manager group. Preferences contains three buttons that you can use to customize the way FM works for you.

Frequency Manager Button

- **Show a signal's description, etc. above the spectrum:** Checking this option enables the Data Display that shows the current frequency's description from the database (if any), its signal strength, and the condition of the timeout, watchdog, and cutoff timers. You may also use controls here to change the color of the text and make the font bold.
- **Show the Minimum Signal Strength line on the spectrum window:** Checking this will enable the horizontal line on the spectrum that indicates the Minimum Signal Strength you have set. You may also change the line thickness and choose from one of 6 predefined line patterns. The line will be the same color as the text defined in "Show a signal's description, etc. above the spectrum".
- **Show descriptions of frequencies on the spectrum:** This will display the Description field from each of your database frequencies on the spectrum along with a line indicating where on the spectrum that frequency sits. This allows you to visually relate an active frequency to a known transmitting station. You may change the colors of the text and the connecting line, adjust the transparency of the text and line, and adjust the vertical space between entries to improve readability. Please note the transparency value; a higher number means more transparency and the more difficult it will be to read the text. See the section "Database Frequency Spectrum Display" for more information on this feature.
- **Change the radio settings using the database's frequency settings when manually tuning:** This will set Mode and other radio settings if you manually tuned to a frequency and that frequency was in the database. When scanning, the radio will always be updated from a database record if one exists.
- **Monitor the clipboard for frequencies:** When checked, FM will monitor the clipboard; if it finds a value that might be a frequency, it will tune the radio to that frequency.



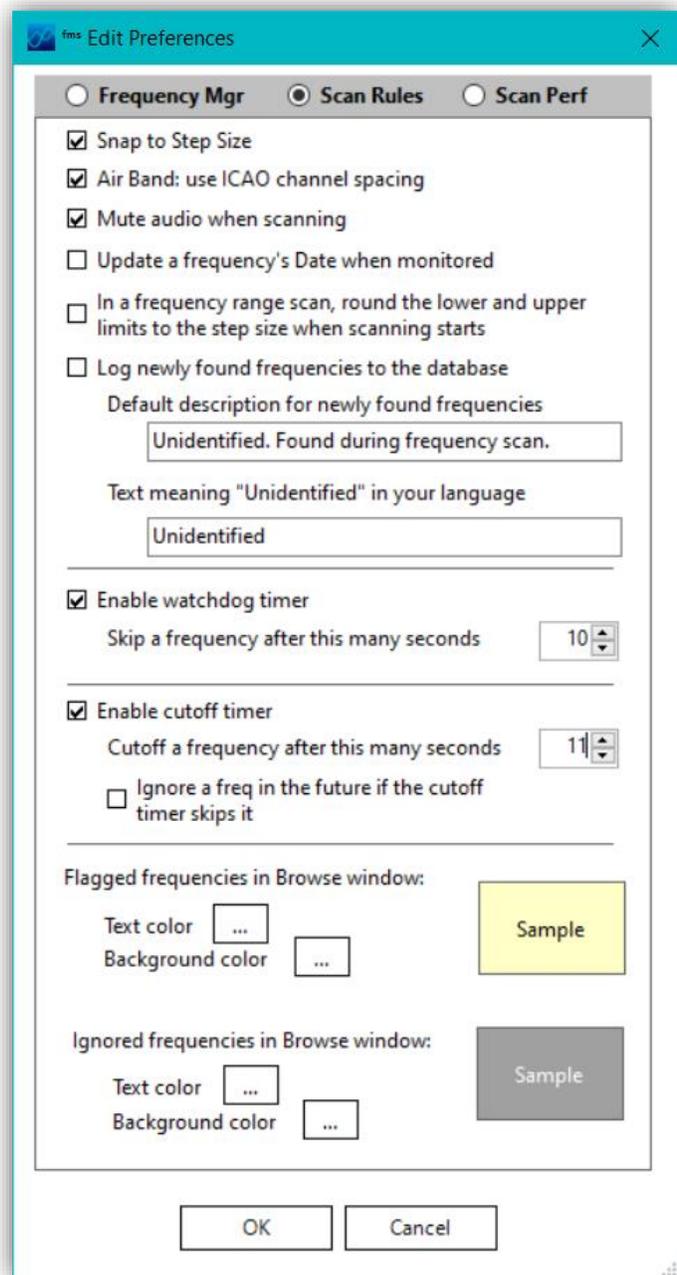
 **Important Note**

This feature is not available for Windows operating systems prior to Windows Vista. If your computer is using Windows XP or earlier, this feature will be disabled.

- **Allow Bulk Edits to change the Last Update field:** Leaving this unchecked will cause the Edit window to retain the original dates and times when bulk-edit records are changed in the database.
- **The current database is:** This allows you to have multiple databases in multiple locations on your computer. The default location for databases is <SDR# folder>\Plugins\FMSuite\FMSuite.Databases. You may have separate databases for types of monitoring or types of transmitting entities; for example, one for HF and another for VHF and UHF; or maybe one for shortwave broadcasts and another for shortwave utility stations. If you specify a database name that doesn't exist, FM will prompt you for permission to create an empty database by that name.

Scan Rules Button

- **Snap to Step Size:** This enables or disables the automatic centering of tuned frequencies to an even step size. The results of enabling this are most evident when tuning NFM or WFM radio signals because at any given millisecond the transmission's peak signal strength is not on the center of the transmission. When enabled, the scanner will always round the tuned frequency up or down to the nearest even step size. When disabled, the scanner will stop on the strongest frequency above the minimum you set; when scanning NFM or WFM, this may not be the center of the signal.
- **Air Band: use ICAO channel spacing:** Air Band scanning is a new feature in this release. When scanning with this enabled and in the VHF Air/Ground Communications Band of 118MHz to 137MHz, the scanner will automatically change the Mode to AM and the Bandwidth to 10,000. This feature scans the standard ICAO frequencies and their 8.3KHz and 25KHz channel spacings. If your range scan starts at a frequency lower than 118MHz or goes higher than 137MHz, the scanner will automatically switch from your Mode to AM and back to your Mode when passing through the Air Band.
- **Mute audio when scanning:** Putting a checkmark here will cause the scanner to mute the audio during scanning, and restore the audio when the scanner stops on a frequency.
- **Update a frequency's Date when monitored:** A checkmark in this box will cause the Date of a monitored frequency that is already in the database to be updated to the current local Date. In addition, the "I've Heard This" flag will be turned on because the frequency was actually monitored.
- **In a frequency range scan, round the lower and upper limits to the step size when scanning starts:** A checkmark here will cause the values you entered as the range scan's lower and upper frequencies to be rounded down and up respectively to the nearest step size as selected in the SDR# Step Bar.
- **Log newly found frequencies to the database:** A checkmark here will cause the scanner to automatically add a record to the database when a previously-unrecorded frequency is found. You may also customize the text that is inserted in the Description field of the record.



- **Text meaning "Unidentified":** When the scanner tunes to a frequency that is not currently in the database, this text will be displayed in the upper right corner of the SDR# spectrum display if “Show a signal’s description, etc. above the spectrum” is checked on the Frequency Mgr tab.
- **Enable watchdog timer:** a checkmark here will force the scanner to continue scanning after stopped on an active frequency for a period of time. If the Scanner Decisions plugin is open, a line with the text “watchdog timed out; scanning resumes” will be displayed. For more information on this timer and how to use it, see the section “Scanner Timers and how they affect each other” in the Appendix.
 - **Skip a frequency after this many seconds:** how long the watchdog timer will wait on an active frequency before forcing the scanner to continue.

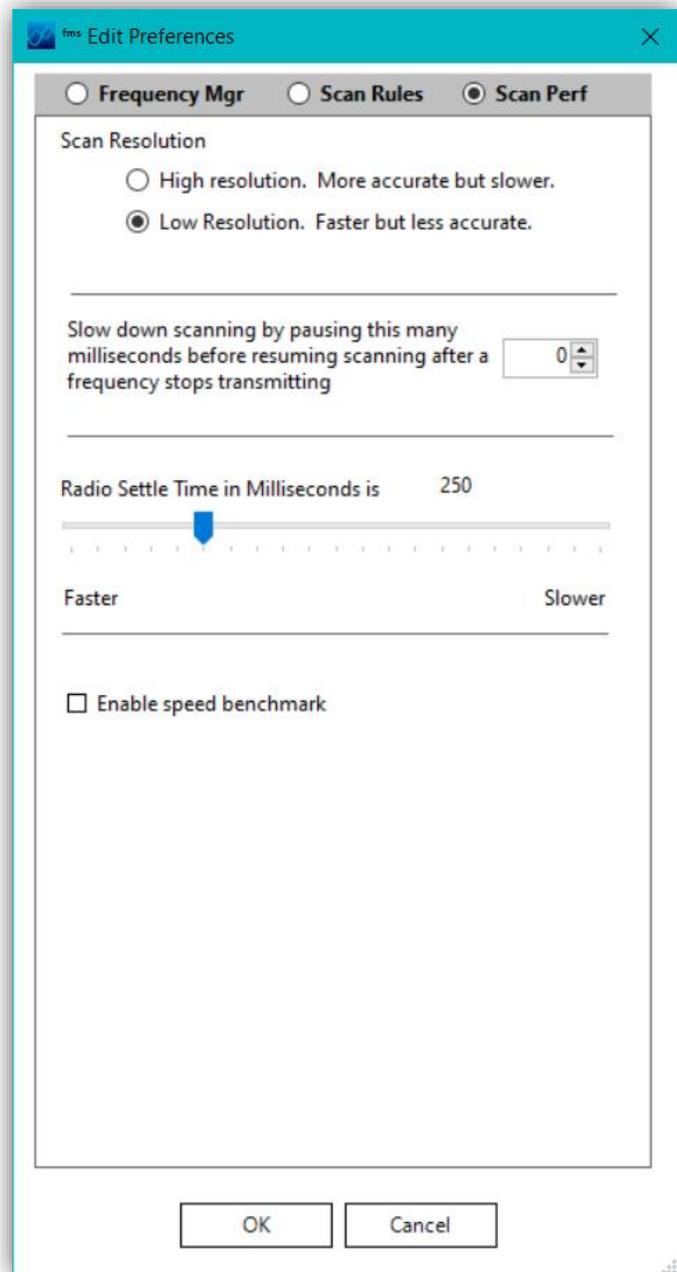
A couple of notes about using the watchdog timer:

- On NFM and WFM signals, the watchdog works best with “Snap to next Step Size” turned on and the radio’s calibration accurate so that the center of the signal is on the step size boundary.
- If a frequency rapidly bounces below and above the minimum dB settings the watchdog timer will not engage; every time a frequency falls below the minimum the watchdog is turned off and the “Seconds wait” timer is turned on. A frequency must be consistently at or above the Minimum Signal Strength for the entire number of seconds you defined for the watchdog before the watchdog will force scanning to resume. You can see these decisions being made by looking for the watchdog “W” on the Signal Strength Indicator. This situation can be mitigated lowering the Minimum Signal Strength or by using the Cutoff timer.
- If the watchdog timer never takes effect, this is usually an indication that the Minimum Signal Strength is set too high (too close to zero dBFS).
- **Enable cutoff timer:** This timer is a last resort for getting the scanner off of a frequency that bounces rapidly below and above the Minimum Signal Strength. In that situation the “Seconds wait for more transmission” and the watchdog timer battle for control of the scanner. The Cutoff timer breaks the deadlock and forces the scanner to move on regardless of whether or not the frequency is active. When the Cutoff timer is enabled the letter “C” will appear on the Signal Strength indicator. For more information on this timer and how to use it, see the section “Scanner Timers and how they affect each other” in the Appendix.
 - **Cutoff a frequency after this many seconds:** how long the cutoff timer will wait before forcing the scanner to continue.
 - **Ignore a freq in the future if the cutoff timer skips it:** a checkmark here will cause cutoff-skipped frequencies to be ignored in future scanning.
- **Flagged Frequencies in Browse window:** Here you may define the colors you want to use to indicate flagged frequencies in the grid of the Browse window.
- **Ignored Frequencies in Browse window:** has the same color choices.

Scan Performance Button

- **Scan Resolution:** Select High Resolution or Low Resolution. The difference is the number of discrete frequencies that will be scanned as a block.
 - High Resolution contains more individual frequencies so it will be more accurate; but scanning will be slower. The number of frequencies is the greater of the FFT Resolution or the radio’s RF bandwidth. For example, if the FFT Resolution is 4096 and the RF Bandwidth is 2.4MHz, the scanner will search 2.4 million frequencies, taken in “chunks” from the data driving the spectrum display’s width.

- Low resolution contains fewer frequencies so it scans faster but will be less accurate because some active frequencies may be skipped. The number of frequencies is lesser of the FFT Resolution or the radio's RF bandwidth. For example, if the FFT Resolution is 4096 and the RF Bandwidth is 2.4MHz, the scanner will search only 4096 samples at a time; which equates to checking 1 frequency out of about every 586 frequencies in a 2.4MHz RF Bandwidth.
- **Slow down scanning by pausing, etc.:** This causes the scanner to pause the specified number of milliseconds when leaving a frequency, just before searching for the next frequency. This feature is only activated when leaving a previously-active frequency. You would not set this above zero for daily use; it is used solely so that you can examine the scanning action without changing your optimized scanning settings. When set above zero, this feature can cause repetitive entries in the Scanner Decisions window or plugin.
- **Radio Settle Time in Milliseconds:** This slider lets you balance scanning speed against scanning reliability. Lower values will give you higher speeds but the scanner may miss some active frequencies. This is because SDR# does not provide a way for plugins to know when the radio has successfully tuned to a specific frequency. So, this value is used to introduce some delay between the time the scanner tells SDR# to tune the radio and the time the scanner starts measuring the actual signal strength. This is the *maximum* time the scanner will use to tune a frequency; in most cases it will take less time, as little as zero milliseconds, because the scanner is continuously sampling the radio to check the signal strength. On my equipment, 250ms is a good balance. This feature is not activated until the scanner tunes to an active frequency.
- **Enable Speed Benchmark:** If you want to know the absolute fastest rate at which your equipment can scan, check this box. See "Benchmarking the Scanner" in the Appendix for instructions.



The OK button saves all the settings in the Preferences window. If you instead wish to abandon your changes without saving them, just click the Cancel button.

The Data Display

The Frequency Manager also includes this section of the spectrum window that is used to display information about the currently-tuned frequency. When not scanning only the Frequency Description is shown.

Frequency Description

If the tuned frequency has a record in the FM database the Description from that record will be displayed here.

A screenshot of a radio display showing the text "Clark, County of [-87dBFS] M T W C" in yellow on a black background. The "M" is bolded.

Current Signal Strength

The signal strength of the tuned frequency is displayed next in a dBFS scale between zero and the maximum display range of your radio. This is only displayed when the scanner is running. The signal strength does not display S-units because S-units are not supported by the design of SDR#.

Multiple-Record Indicator

The **M** to the right of the signal strength indicates that your database contains multiple records for this frequency. This is useful because, when hand-entering a frequency into the radio or when scanning by frequency range, the Description shown will be that of the first record found in the database for that frequency. Therefore, any transmission you listen to may or may not be correctly attributed to the Description shown. There's no way FM can tell from a transmission which licensee is transmitting it; the best it can do is tell you that you have multiple records for that frequency so that you can decide for yourself who is transmitting.

Timeout Timer Activity

The **T** to the right of the Multiple-Record Indicator, when displayed, indicates that the signal's strength has fallen below the minimum that you defined and the scanner is waiting for an additional transmission. It will wait as many seconds as you defined in "Seconds wait for more transmission" and if the frequency does not resume activity, the scanner will start searching for the next active frequency.

Watchdog Timer Activity

The **W** to the right of the Timeout Timer Indicator indicates that (a) you have enabled the watchdog timer and (b) the frequency has been active for a long enough time that the watchdog is prepared to stop listening and move on to the next frequency when the timer runs out.

Some notes on the operation of the Data Display when showing the T and W indicators:

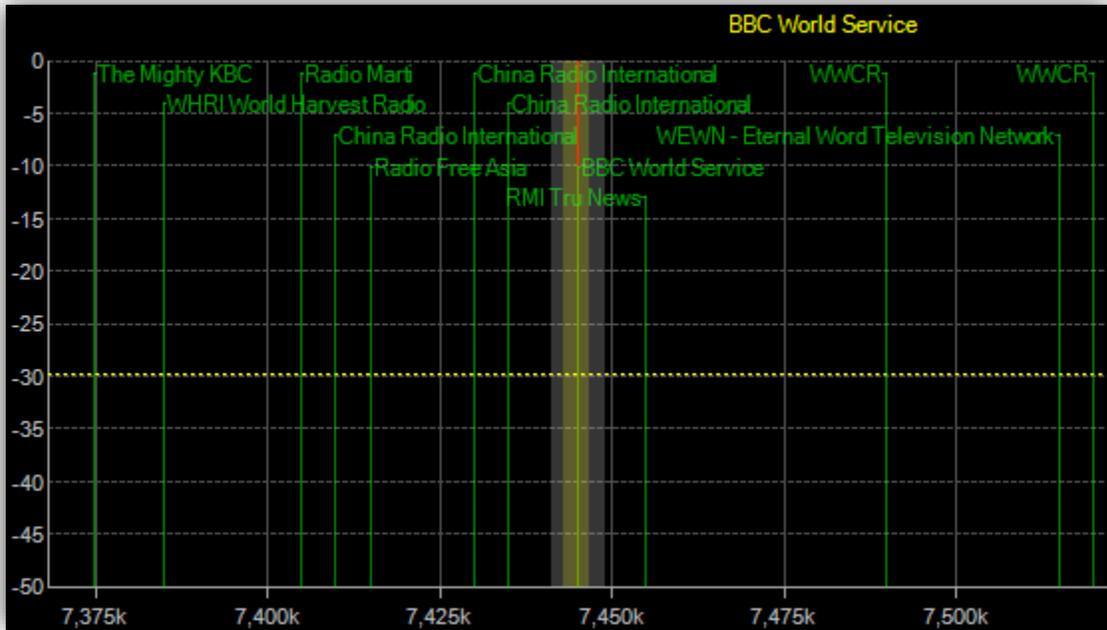
- The T and W timers are controlled by the signal strength of the tuned frequency and are mutually exclusive; they cannot both be active at the same time because their purposes are the opposite of each other. The timeout timer waits on a previously-active but now inactive frequency to become active again and then forces the scan to resume when time runs out. The watchdog timer waits on an active frequency to stop transmitting and forces the scan to resume when the signal is active for too long. These timers are only displayed when the scanner is running.
- The T and W indicators may not always display during times of fast signal strength changes that cross the minimum signal strength; they can flicker on and off so fast that your computer may not be able to keep up.

Cutoff Timer Activity

The **C** to the right of the Watchdog Timer indicates that (a) you have enabled the cutoff timer and (b) it is counting down to automatically skipping the currently-tuned frequency. For more information on this timer and how to use it, see the section "Scanner Timers and how they affect each other" in the Appendix.

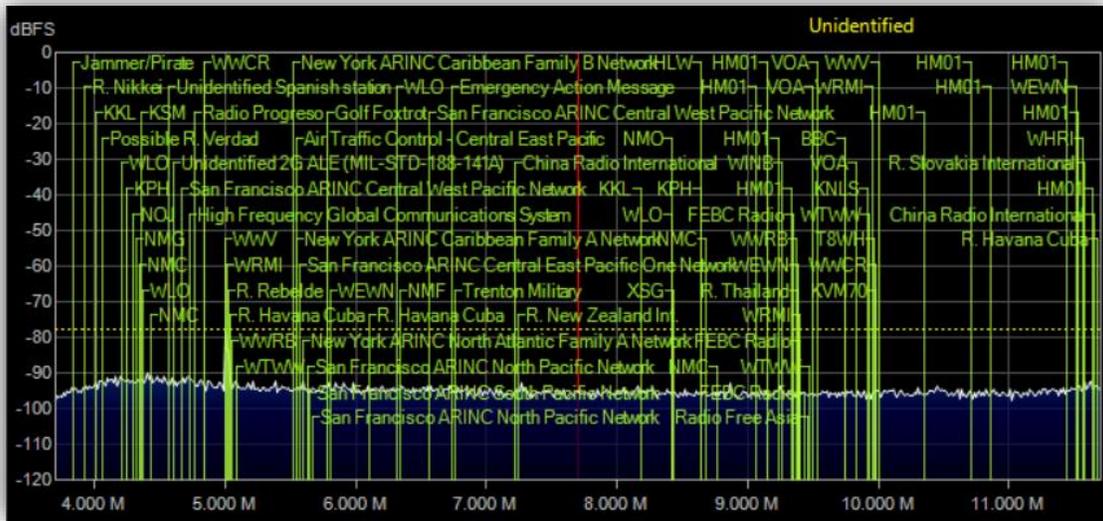
Database Frequency Spectrum Display

This option, controlled in the Frequency Manager button of the Preferences window, will dynamically display the description field of the frequencies in your database that fall within the current frequency range of the spectrum analyzer and which have the related checkbox marked in their Edit windows. You may choose your own colors for frequency text and the indicator line, as well as the transparency of the text and the vertical space between rows of text.

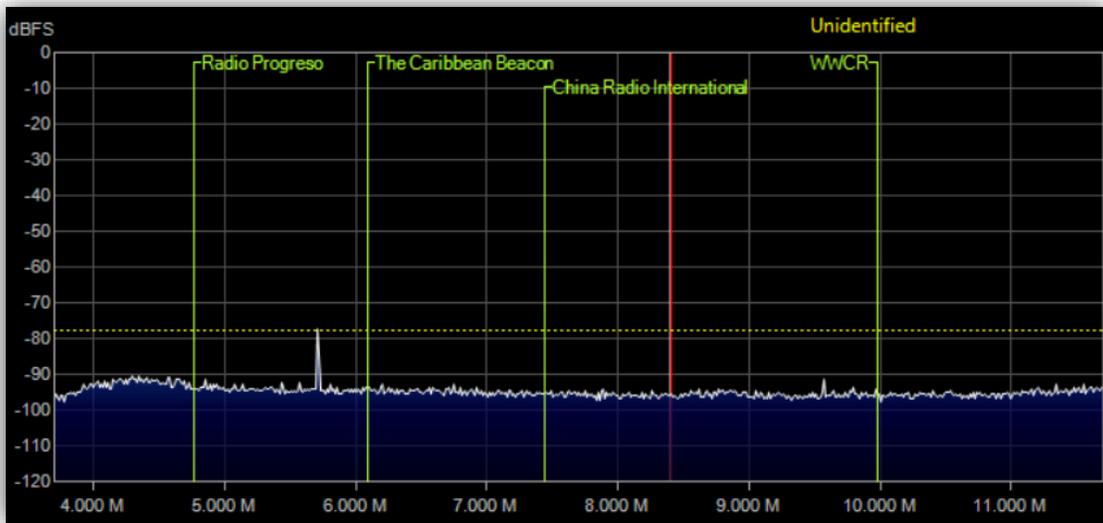


By checking or unchecking the relevant checkbox in the Edit window, you control whether every frequency displays on the spectrum when this feature is enabled in the Preferences window.

By checking the box on the frequencies that you are most interested in you change this example (as in previous versions of FM):



Into this:



The Scanner Panel

The scanner allows you to select and scan a Group of frequencies that you have previously defined, or to scan a range of frequencies that you specify. Scanning speed depends on the performance of your computer and your radio. The scanner cannot be used for "IQ File" or "Other" signal sources.

The scanner achieves its speed by looking ahead at the spectrum to the right of the SDR# vertical red line that indicates the current frequency. So, the further to the left of the spectrum that the red line is located, the more

spectrum the scanner can search in one large block, and the faster overall the scanning will be. This permits scanning at a higher speed, especially during frequency range scans.

A Group scan looks for the next frequency of the Group in the current block of spectrum; if the frequency is not active the spectrum is advanced to the next frequency in the group, and so on. If the target frequency is not in the current block of spectrum the scanner tunes to the next block and starts looking for the target frequency. A Range scan searches the current spectrum for the next frequency whose signal strength is higher than the specified minimum; if no frequency is found the spectrum is advanced to the next block of frequencies.

Personally, I get the fastest VHF/UHF range scans by putting that red line almost all the way to the left, usually about 10% into the spectrum from the left edge. This is because there's a larger "chunk" of frequencies in the current spectrum to examine all at once.

If the Browse window is open and Live Track is enabled, you will see frequencies in the database highlighted in the Browse window as the scanner tunes them.

The scanner stops on a frequency when it detects the frequency is stronger than a minimum decibel level that you define.

Functions in the Scanner Panel

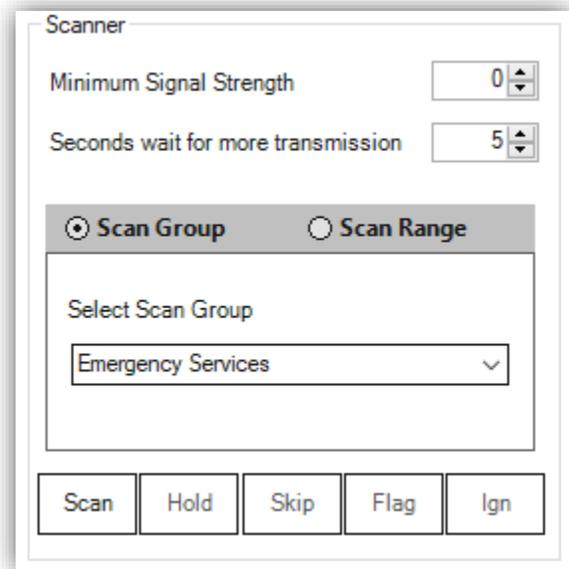
Minimum Signal Strength

This control lets you define the minimum signal strength in dBFS that will cause the scanner to stop on a frequency. This value governs both Group and Range scans. I won't go into what dBFS is (you can look that up) but keep in mind **the closer to zero, the stronger the signal**. You may type a number in this field or use the up and down buttons to change the setting. Because the dBFS level is defined as a negative number, any positive number that you type will be converted to a negative number when you leave the field. This value can be changed while the scanner is running and the change takes effect on the next frequency scanned.

The Minimum Signal Strength is represented by a horizontal line in the spectrum display, if enabled in the Preferences window. By default, this is a yellow line; but you can change the color easily using the Preferences window. The purpose of this indicator is to provide you information about the current signal strength versus the minimum that you defined.

Seconds wait for more transmission

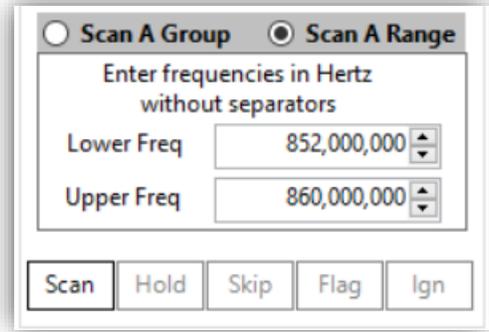
VHF and UHF transmissions are sometimes conversations between a base station and a mobile unit. You probably want to hear both sides of the conversation, and there are often a few seconds of pause between each side of the conversation; so, set this value to wait long enough to allow a response in the conversation before moving on. The minimum value is 0 seconds and the maximum is 600 seconds (10 minutes). This value can be changed while the scanner is running and the change takes effect when the next active frequency is found; however, if changed while the watchdog timer is counting down this value is ignored until the scanner stops on the next active frequency and the watchdog timer restarts. For more information on this timer and how to use it, see the section "Scanner Timers and how they affect each other" in the Appendix.



Scan Mode

This is a pair of buttons that allow you to select the scan mode: scan by a specified group or scan by a specified range of frequencies.

- **Scan Group:** In order to use this function, you must first have created a group and assigned frequencies to the group as described in the Edit window section. Select the “Scan Group” button. The group you wish to scan can be selected in the dropdown list. As a practical matter, keep your groups small enough to improve your chances of detecting an active frequency in a reasonable length of time in scanning. Your database settings for Mode, Shift, etc. for each frequency will be applied to SDR# when the scanner stops on an active frequency in the group.



Hint

Group management is a key part of group scanning. I find it useful to have a group containing all the frequencies I can find for that group just so they are organized for the Browse window; and I make a *second* group containing a subset of the first group, limited to the most active or interesting frequencies. For example, I have a group named “Emergency Services” that contains 100 frequencies and a subset named “Scan Emergency Services” that contains the 20 most active frequencies. By limiting the scope of a Group scan you improve Group scanning performance.

- **Scan Range:** To scan a range of frequencies take the following steps:
 1. Select the “Scan Range” button.
 2. Enter the starting Lower Frequency and the ending Upper Frequency. If rule “In a frequency range scan, round the lower and upper limits to the step size when scanning starts” is checked in the Preferences window, then whatever you enter will be adjusted to a correct figure based on the currently selected Step Size in SDR# when you click Scan. For example, with a Step Size of 12.5 KHz, a Lower Freq of 160,606,000 Hz will be normalized downward to 160,600,000Hz and an Upper Freq of 161,117,205 will be normalized upward to 161,125,000Hz.

Hint

By default, automatically-logged new frequencies have a Description of “Unidentified. Found during frequency scan.” This text can be changed to suit your preferences or language; please see the section of this document that describes the Preferences dialog.

Hint

When performing a frequency range scan, the scanner tries to match the frequency of a found signal to one in your database. If “Snap to next Step Size” is turned off and you are tuning an NFM or WFM frequency, a database match may not be found because in NFM and WFM transmissions the peak frequency moves left and right around its center; at any given moment the peak will be off-center and therefore may not have a match in the database.

Scan button

The scan button starts and stops the scanning action. If the radio is not playing, scanning begins after a 1-second delay to allow the radio to start. When scanning, some controls in the Scan Functions group are disabled. Please note that if you turn off the radio using SDR#’s Stop button, the scanner continues to run until you click the scanner’s Stop button.

Please note that the red line in the SDR# spectrum window indicating the current frequency behaves differently when using Send to Radio from the Browse window versus when scanning. When scanning, the frequency

difference between the current center frequency and the current frequency is maintained to keep the red line at the same position in the spectrum analyzer. When using Send to Radio from the Browse window, the center frequency and frequency recorded in the database are sent to the radio, which may cause the red line to change position.

Hold button

Sometimes when scanning you hear a particularly interesting conversation and want to listen to it without needing to stop the scanner and restart scanning when done listening. Clicking this button will cause the scanner to ignore the “Seconds wait” value and the watchdog timer, and its caption to change to “Rls” (Release). The scanner will stay on the current frequency. The button stays pressed until you click it again, at which time the “Seconds wait” value is applied and the scanner electronically clicks the Skip button when the timer expires.

Skip button

Sometimes when scanning you will land on a busy frequency, or one that has a long-winded and boring conversation, or perhaps radio interference. Clicking the Skip button tells the scanner to move on to the next frequency. The Skip button restarts the scan at the current frequency + the step size. Skipping an active frequency works best when “Snap to next Step Size” is turned on. The Skip button does not prevent you from scanning that frequency again.

Flag button

The Flag button marks the current frequency as something “interesting” that you wish to follow up on later. These frequencies can be easily found in the Browse window by using the Flagged/Locked filter. In the Browse window these are also colored differently than “normal” frequencies; by default, standard Windows colors are used but the colors can be customized to your liking. See the section of this document that describes the Preferences dialog to determine your preferred colors. When you click the Flag button, the frequency in the database has its Heard value set to True.

Ign (Ignore) button

The Ignore button marks the current frequency to be ignored in future scanning and then electronically clicks the Skip button. The change takes effect immediately; the next time the current scan hits an ignored frequency it will be skipped. These frequencies can be easily found in the Browse window by using the Flagged/Ignored filter. In the Browse window these are also colored differently than “normal” frequencies; by default, standard Windows colors are used but the colors can be customized to your liking. See the section of this document that describes the Preferences dialog to determine your preferred colors.

Troubleshooting

I wish I could say that there will never be any challenges, but in reality, stuff happens. If a significant error occurs in FM its details will be written to a file <SDR# folder>\Plugins\FMSuite\FMSuiteException.txt. The Exception file will contain some details about the problem, and if the file already exists (due to previous errors)

new errors will be appended to the file. NOTE that only significant, usually fatal, errors will be recorded there; most errors and their details will be simply displayed on the screen.

Please try the following remedies if you have these problems.

Error Messages

Problem	Potential Solution(s)
<p>A popup appears with the message <i>"An error occurred. The error was: Cannot set the center frequency when no front end is connected"</i>.</p>	<p>You cannot scan unless a radio is selected as the signal source. Drop down the Source list (in the SDR# Source panel) and select a radio.</p>
<p>A popup appears with the message <i>"An error occurred. The error was:"</i> followed by some text then <i>"SQLite error no such column"</i> or <i>"SQLite error no such table"</i>.</p>	<p>The file "System.Data.SQLite.dll" did not get installed into the SDR# folder, or was installed but is locked by Windows so that it cannot be used. Close SDR#.</p> <ul style="list-style-type: none"> • Check folder <SDR# folder>\Plugins\FMSuite for this file. If it was not installed, uninstall all of FMSuite after making backups of your databases and log data. Make sure you have Modify or Full Control access to the SDR# folder, and attempt to install the software again. • If the file exists, it may have been locked by Windows. Right-click System.Data.SQLite.dll and select Properties from the menu. On the General tab, if there is an "Unblock" button, click it; then close the Properties window and try to use the plugin again.
<p>A popup appears with the message <i>"An error occurred. The error was:"</i> followed by some technical information.</p>	<p>This is rare and usually happens when there is a problem with the database.</p> <ul style="list-style-type: none"> • Stop and close SDR#. Make sure no other processes are using the database – for example a backup program or a database editor. Restart your computer if necessary to be sure. • Ensure that you have sufficient Windows permissions to alter the database and the folder that contains it. • If the problem continues, please send an email which includes all of the text in the popup plus the steps you took to get the error to the address on the 1st page of this document.
<p>A popup appears with the message <i>"The Frequency Manager database exists but it is damaged. Do you want to delete it and create a new database?"</i></p>	<p>During startup FM detected that the database exists but appears to be corrupt. Your options are:</p> <ul style="list-style-type: none"> • Click Yes to continue and replace the damaged database with a new empty one. You will have to rebuild your data. • Click No, exit SDR#, and restore the database from a backup. (Why don't you have a backup?) • You may attempt to use the Data Tools Wizard to export the data from the damaged database to a CSV file, and then import it into a new database. If the corruption is bad enough this will not succeed.
<p>Other popup errors are shown.</p>	<p>If it is an FM Suite error, the popup will contain details. Copy the details (CTRL+C usually works) and email them to the address at the top of this document along with the steps necessary to reproduce the error. I will give you advice on what you can do to resolve the issue if that is feasible, or attempt to identify and fix the problem if it is a programming issue.</p>

Problem	Potential Solution(s)
Scanner Decisions shows the error message "Detected but SDR# couldn't set the radio to this frequency. Make sure that frequency is in the radio's acceptable range and that any database record for it is correct."	Sometimes SDR# is not able to tune to the target frequency. This can happen often with inexpensive radios but also happens less frequently with expensive radios. The exact cause of the problem is unknown. The Scanner requests that SDR# tune to a specific frequency and then waits up to 2 seconds to confirm the frequency was set. If after 2 seconds the frequency has not been set, the Scanner states this error message in Scanner Decisions and moves on to the next target frequency.

Operational Issues

Problem	Potential Solution(s)
The Frequency Manager + Scanner panel is disabled; no controls can be used.	Some critical error was detected that would prevent FM from working correctly. When this happens you normally will see an error message before SDR# finished loading. Some reasons for this can be: <ul style="list-style-type: none"> • The selected FM database is unusable. • The selected FM database cannot be found. • FM could not be loaded, usually due to a configuration error or a problem with the database software. You may need to reinstall FM.
The scanner never stops on an active frequency.	Check these settings for these problems: <ul style="list-style-type: none"> • The Minimum Signal Strength is set too high. • In Preferences > Scan Performance, the Radio Settle Time in Milliseconds is set too low.
The scanner changes frequencies slowly, especially during a Group scan.	<ul style="list-style-type: none"> • The VFO frequency doesn't change unless an active frequency is found or the next target frequency is outside of the current spectrum, so it might appear that the scanner is slow but it is actually searching the current spectrum window for activity. You can confirm that the scanner is working correctly by opening the Scanner Decisions plugin and watching the frequencies as they are scanned. • In Preferences > Scan Performance, the "Radio Settle Time" value is set too high. This causes the scanner to wait longer than necessary to detect that the frequency is inactive and then move on. • In Preferences > Scan Performance, the "Slow down scanning" etc. value is greater than zero.
The scanner changes frequencies shortly after stopping on an active frequency.	<ul style="list-style-type: none"> • The Minimum Signal Strength value is too high, and the signal level fell below the minimum for longer than the "Seconds wait..." value. For more information, see the Appendix article "The Spectrum Analyzer Lies to You". • The Watchdog timer is enabled and set to too low a value. Disable it or set the delay to a longer time. • The Cutoff timer is enabled and set to too low a value. Disable it or set the delay to a longer time.

Problem	Potential Solution(s)
<p>The scanner stops just to the right or left of an active frequency.</p>	<p>There are several common causes for tuning off-center of an active frequency:</p> <ul style="list-style-type: none"> • You are doing a Group scan and the frequency to the right or left is not in the group. The scanner stopped on a frequency that <i>is</i> in the group. • You are doing a Range scan and the frequency's strength did not meet the minimum signal strength, so the scanner moved on. The scanner stopped where it did because the second frequency's signal strength qualified it for stopping. • The skipped frequency is not eligible for scanning – for example it may be marked to be Ignored. If it “splatters” into the adjacent step size and “Snap” is enabled the scanner may stick on the empty, non-ignored frequency because it can “see” the splatter and thinks that is part of the target frequency. Make sure the SDR# Step Size is suitable for the transmission Mode (NFM, AM, etc.). • The frequency is correct and eligible but the scanner doesn't stop on it because its bandwidth is too narrow for the step size; the scanner doesn't “see” the frequency in the spectrum. For more information, see the Appendix article “The Spectrum Analyzer Lies to You”. • The “Radio Settle Time” value is set too low. Try increasing the value 50ms at a time until the scanner stops correctly.
<p>The scanner skipped over a frequency that I know is active and which should have been selected.</p>	<p>Even though the frequency apparently qualified for scanning it could be skipped for the following reasons. See the Appendix articles “The Spectrum Analyzer Lies to You” and “Scanner Performance Tuning” for more information. Assuming the frequency was not marked to be Ignored:</p> <ul style="list-style-type: none"> • The Minimum Signal Strength is set too high for that frequency – the actual signal strength <u>at the time it was measured</u> after tuning was below the minimum. You can see the measured signal strength in the Scanner Decisions plugin. • In the Scanner Configuration window, the “Radio Settle Time” is set too low (the scanner didn't have enough time to measure the signal). • The radio's Frequency Correction (PPM) value is incorrect, and although the frequency looks centered under the red line in SDR# it is not on the correct frequency. If you use the SDR# Zoom slider you might be able to see this in action. • The transmission has a bandwidth that is smaller than the step size, and is too far away from the center of the bandwidth, resulting in too little of the transmission being measured for signal strength – the scanner thinks the signal is too weak because it can't “see” the entire signal. Make sure the step size you set is correct for the transmission Mode (NFM, AM, etc.)

Problem	Potential Solution(s)
The scanner jumps to a frequency and stops. The frequency is not active.	<p>Possible reasons for this:</p> <ul style="list-style-type: none"> • The frequency was busy when the scanner was stopped, but fell below the minimum or stopped transmitting immediately after tuning. The scanner is waiting for the frequency to have additional transmissions before moving on. The “T” symbol will be displayed in the upper right of the spectrum analyzer. • An adjacent frequency takes up more spectrum than it should for the Step Size (it “splatters”) and the scanner senses enough of that signal to think that the frequency that it stopped on is the active one. This often happens due to radio interference from nearby electronic devices. • Confirm that the step size is appropriate for the transmission mode; if the step size is too large the scanner can “see” the unwanted freq and may get stuck. Consider using the SDR# co-channel interference plugins as a possible solution.
The scanner stops on an active frequency but there is no sound.	<ul style="list-style-type: none"> • The transmission could simply have no audio – an open carrier meeting the minimum dBFS will cause the scanner to stop and listen. • Make sure SDR#’s audio is not muted.
The watchdog timer never resumes scanning.	<p>Possible reasons for this:</p> <ul style="list-style-type: none"> • The watchdog only works when a frequency’s signal strength is at or above the minimum dB for the number of seconds set for the watchdog. If a frequency’s peak is very near the Minimum Signal Strength you set, and the frequency’s strength bounces below and above that Minimum Signal Strength, the watchdog will never fire because it gets reset every time the signal strength goes below the Minimum Signal Strength. Fix this by changing the Minimum Signal Strength to a figure lower than the lowest dBFS a particular frequency falls to while it is active. • You may also watch this happen by looking for the “W” symbol on the Signal Strength Indicator; if the “W” doesn’t appear, the watchdog timer is not engaged. Clicking the Skip button will sometimes correct this.
I click in the Lower Freq or Upper Freq boxes to type a frequency, but nothing happens when I type.	<p>SDR# has a trick: whenever your mouse is over the spectrum display or the waterfall display, SDR# “helpfully” steals the focus from the Freq entry boxes to the spectrum display.</p> <ul style="list-style-type: none"> • Try clicking in one of the Freq boxes and then move the mouse <i>up</i> and out of the way instead of to the right and over the waterfall. • Move the FM+S panel to the right of the spectrum display, not the left.
The Scanner Skip feature isn’t working	<p>Skip will not work reliably if there is a mismatch between the Mode setting and the Step Size setting. Set the correct step size for the transmission Mode.</p>

Known Issues

- There is an issue in theming unrelated to FMSuite and generated by SDR#/Telerik. Sometimes changing themes (depending on the chosen themes) causes SDR# and FMSuite plugins to display with the wrong color palette making the text of controls the same color as the background color. For example, select the Office 2007 Black theme. Then, select the Office 2007 Silver theme. The plugins are filled with a muddy green color and you cannot see the labels on controls. If you close and reopen SDR# at this point the problem goes away and the correct Office 2007 Silver colors are used. This has been tested on multiple computers having different video cards and video drivers.

Appendix

Default Protocols supplied with Frequency Manager

- 110A
- 1382
- 141A
- 4285
- ACARS
- ALE400
- AM
- AMTOR-ARQ
- AMTOR-FEC
- ARQ-E
- ASCII
- BPSK125
- BPSK250
- BPSK31
- BPSK63
- CCW
- CHIP
- CONTESTIA8/250
- Contestia8/500
- Contestia16/500
- Contestia3211000
- Contestia4/125
- Contestia4/250
- Contestia4/500
- Contestia8/1000
- Contestia16/1000
- Contestia8/2000
- Contestia16/2000
- Contestia3212000
- Contestia64/2000
- COQUELET
- CW
- DAB
- DominoEX-11
- DominoEX-16
- DominoEX-22
- DominoEX-4
- DominoEX-5
- DominoEX-8
- DominoF
- DTMF
- ERMES
- FEC31
- FELDHELLX5
- FELDHELLX9
- FSKHELL105
- FSKHELL245
- FLEX
- FMHELL
- FMNARROW
- FMWIDE
- GMDSS
- HELL80
- HFFAX
- HFDL
- IEC870-5
- JT65
- Lentus
- LSB
- MFSK-16
- MFSK-32
- MFSK-4
- MFSK-64
- MFSK-8
- MOBITEX
- MT63-1000
- MT63-2000
- MT63-500
- NAVTEX
- NWR
- Olivia8/250
- Olivia8/500
- Olivia16/500
- Olivia32/1000
- Olivia4/125
- Olivia4/250
- Olivia4/500
- Olivia8/1000
- Olivia16/1000
- Olivia8/2000
- Olivia16/2000
- Olivia32/2000
- Olivia64/2000
- P25
- PACKET
- PACTOR
- PAX
- POCSAG
- PSK10
- PSK220F
- PSK63F
- PSKHELL
- PSK63FDIGISSTV
- PSKAM10
- PSKAM31
- PSKAM50
- QPSK125
- QPSK250
- QPSK31
- QPSK63
- QRSS
- RTTY100
- RTTY110
- RTTY150
- RTTY200
- RTTY45
- RTTY50
- RTTY75
- RTTYM8/250
- RTTYM8/500
- RTTYM16/500
- RTYM32/1000
- RTTYM4/125
- RTTYM4/250
- RTTYM4/500
- RTTYM8/1000
- RTTYM16/1000
- RTTYM8/2000
- RTTYM16/2000
- RTTYM32/2000
- RTTYM64/2000
- SELCAL
- SITORA
- SITORB
- SLOWHELL
- SSTV
- SYNOP
- THOR16
- THOR4
- THOR8
- THROBX-1
- THROBX-2

- THROBX-4
- THROB-1
- THROB-2
- THROB-4
- Unidentified
- USB
- Voice
- WEFAX-IOC288
- WEFAX-IOC576

Default Services supplied with Frequency Manager

- Aeronautical
- Business
- Broadcast
- Corrections
- Data
- Emergency Ops
- EMS Dispatch
- EMS Tactical
- EMS Talk
- Federal
- Fire Dispatch
- Fire Tactical
- Fire Talk
- Ham
- Hospital
- Interop
- Law Dispatch
- Law Tactical
- Law Talk
- Maritime
- Media
- Military
- Multi-Dispatch
- Paging
- Public Safety
- Public Works
- Schools
- Security
- Standard Frequency
- Transportation
- Trunked
- Unidentified
- Utilities

Scanner Timers and how they affect each other

There are three Timers in the scanner:

- Seconds wait for more transmission (“T”)
- Watchdog timer (“W”)
- Cutoff timer (“C”)

How they work and interact is as follows:

- The Seconds wait for more transmission timer, after a frequency stops transmitting, waits to give the frequency another chance to transmit before resuming scanning of frequencies. This action is taken so that you can catch both sides of a conversation that occur on the same frequency.
- The Watchdog timer starts when a frequency starts transmitting. If the frequency is still transmitting when the timer counts down to zero, the timer forces the scanner to leave the frequency and resume scanning. This prevents the scanner from getting trapped on a frequency that is continuously active (e.g., a digital data transmission that never stops)
- The Cutoff timer is a referee between the other two timers. In some circumstances a frequency can be barely above the Minimum Signal Strength that you set but still qualified, and its signal strength (especially on an NFM signal) can bounce above and below the Minimum Signal Strength. In these cases, the Seconds wait timer and the Watchdog timer take turns switching on and off rapidly with neither timer being active long enough to force scanning to resume. The Cutoff timer is the absolute maximum in seconds that the scanner will wait on a frequency. In the case where the Seconds wait and Watchdog timers are battling for control of the scanner, the Cutoff timer breaks the tie and forces the scanner to resume.

For the best performance you should set the timers as follows:

- Set the Seconds wait for more transmission timer to the maximum number of seconds you want to wait to allow a frequency to resume transmission, before the scanner resumes scanning.
- Set the Watchdog timer to the maximum amount of time you want the scanner to stay on an active frequency; this will be higher than the Seconds wait timer.
- Set the Cutoff timer a little higher than the Watchdog timer, so that scanning resumes even if the other two timers don’t run down.

Put another way:

- The Seconds wait for more transmission timer should have the smallest number of seconds.
- The Watchdog timer should have a slightly larger number of seconds.

- The Cutoff timer should be at least 1 second longer than the Watchdog timer.

WFM DXing with the Frequency Manager + Scanner

This article was written and graciously provided by longtime FMSuite user and beta tester David Bunyan.

A popular use of SDR radios and software is DXing for WFM stations and capturing the RDS/RBDS [Radio (Broadcast)Data System] information for station identification and proof of reception. DXing means listening to far-away — usually foreign — radio stations.

A comprehensive list of FM broadcast stations throughout the world is available on FMList.org. Anyone interested can access it and can set up a personal database to log reception.

Using the Vasili's SDR# MPXOutput Plug in¹, the Virtual Audio cable (VAC) program², and the program RDSSpy³ you can capture the RDS data to a csv file and marry it up with the frequency data in FMSuite's Activity Log. RDSSpy is noticeably more sensitive than the in-built RDS decoder in SDR#.

I won't get into capturing RDS data in this guide as you can get all the needed information off the web, but here are some tips for configuring the Frequency Manager + Scanner for DXing WFM broadcast stations.

Create a WFM DX Group

Add the frequencies you want to search in the appropriate FM database and then create a group just for those frequencies. You want to avoid including local frequencies in this group in order to minimize scanning time. You can also create a group containing all the frequencies for testing purposes in order to optimize performance with your individual set-up.

Configure SDR#

- In the **Step Bar**, set the Step Size to the channel spacing for the WFM band you are searching. This value varies by country although most countries use 100kHz or 200kHz spacing. Note: the OIRT band uses 30 kHz spacing, but these stations don't generally carry any RDS data.
- In the **FFT panel**, set the resolution to 16384 – the lower the figure the less CPU load but the poorer the resolution.

Configure Frequency Manager + Scanner

Make the following settings to the Scanner group in the Frequency Manager + Scanner plug-in.

- **Minimum Signal Strength** should be set to a value suitable for the expected signal strength of DX stations. A minimum signal strength of around 12dB above the noise floor is a good place to start. You can adjust this when the scanner is running to ensure the scanner stops on active stations.
- **Seconds wait for more transmission** should be set to 1. This will prevent the scanner moving to the next frequency due to brief changes in the signal strength when the modulation changes, but still allow the scanner to move on if the signal fades.
- **Make the following settings in the Preferences window.**

In the Scan Rules button

- Put a check mark next to **Snap to Step Size**.
- Remove a check mark next to **Enable watchdog timer**.
- Put a check mark next to **Enable cut-off timer** and set its value to 6 seconds – as this will give ample time for the RDS signal to be decoded without slowing the scanning down too much

In the Scan Performance button

- Set **Scan Resolution** to Low Resolution. If using an SDR with a wide bandwidth you may use the Zoom feature in SDR# to show only around 1 MHz of the spectrum if you are more comfortable with that.
- Configure **Slow down scanning by pausing...** to 200 milliseconds. Ordinarily this should be set to zero; we do this for WFM DX to improve the chances of catching the next station when it is very close to the current one.
- Configure **Radio Settle time...** to whatever works best for your particular radio – default is 500 mS.

Configure the Activity Logger

Enable the Activity Logger plug-in so that it records the frequencies that the scanner stops on – otherwise you will not be able to match the data in the RDSSpy log with a frequency.

- Put a check mark next to **Write Column Headings to log.**
- Put a check mark next to **Don't log activities shorter than.**
- Choose the value – suggested figure **1 second.**
- Click the **Start Logging** button.

The log is saved to a file in the format “yyyy-mm-dd hh:mm” in a sub-folder under the SDR# folder which is called <SDR# folder>\Plugins\FMSuite\FMSuite.Activity.Logs.

Optional Settings

You can choose to display the following – but they add to the CPU load:

- The minimum signal strength line on the spectrum.
- The station name recorded in the database on the spectrum.
- The scanner decisions plugin or window. These are useful when optimizing FM Suite.

When you are ready, select the group you created containing the target frequencies you wish to monitor and start a Group scan.

¹ <http://rtl-sdr.ru/>

² <http://software.muzychenko.net/eng/vac.htm>

³ <http://rdsspy.com/>

The Spectrum Analyzer Lies to You

But it is not a bug, it is not a design problem, and SDR# is doing exactly what it should. It's a matter of physical limitations.

SDR# reads the full spectrum of available frequencies from your radio. For many \$20 dongles, this comes to 2,048,000 frequencies in one huge block. SDR# simply cannot fit that many frequencies into the small spectrum analyzer graph. On my 1920 pixels-wide monitor, with the SDR# window maximized, the spectrum analyzer is 1300 pixels wide. That is the just the graph area and does not include the black border space or the X and Y axis labels. 2,048,000 won't fit into 1300; in fact, in this case SDR# is plotting only about 1 out of every 1575 frequencies of spectrum. So, there are active frequencies that may not even show up on the spectrum analyzer, and signals that show up but are only partially displayed.

The point is that the spectrum analyzer is *representative* of the spectrum but does not display the *actual* spectrum, and you need to keep this in mind when using the spectrum analyzer to watch the actions of the scanner. The scanner is looking at the raw data that supplies the graph, not at the graph itself; and it may see active frequencies that you don't – and you might think it was a false positive.

Another issue of which you need to be aware is that frequencies lose and gain strength quite rapidly, and due to the reduced resolution of the spectrum display a frequency looks like it meets the minimum signal strength for the scanner but in actuality it may vary in strength and be close to, but below, the minimum at the time of measurement. Using the Scanner Decisions plugin and the Signal Strength Indicator will help you understand when a frequency is a mere 1dB in signal strength lower than the minimum required. You may also use the SDR# Zoom slider to magnify a specific frequency to see its strength in relation to the Minimum Signal Strength that you defined.

Scanner Performance Tuning

Overview

Tuning the scanner for maximum performance is as much an art as a science. I'm going to explain your options for tuning and will cover some technical background so that you understand the impact of your choices.

To give you some perspective in later discussion, here's the information about my equipment relevant to performance.

- Six-core CPU at 3.7 GHz with Hyper-threading enabled, resulting in 12 logical processors.
- 32GB memory.
- Airspy R2.

Minimum Signal Strength

The scanner will not stop for a frequency whose signal strength is less than this value. Remember: **the closer to zero dBFS, the stronger the signal**; the closer to -130 dBFS, the weaker the signal. Put another way: the higher the peak on the spectrum analyzer graph, the stronger the signal.

When the scanner is running it examines every frequency it detects and compares the instantaneous signal strength as reported by SDR# against the "Minimum Signal Strength" value. The more negative the Minimum Signal Strength value, the more frequencies on which the scanner will stop. Conversely as the minimum moves up towards zero, only the stronger signals are detected and the scanner will not stop as often.

Many frequencies' signal strengths jump up and down during a transmission so you should set the minimum signal strength for the lowest acceptable value, not the peak value. Here are a couple of scenarios to illustrate the importance of a proper setting:

- **Scenario 1:** You set the minimum at -30dBFS. A signal is found that is at -28dBFS so the scanner stops. The signal then drops to -31dBFS which disqualifies it. The signal never goes above -30dBFS again so the signal gets timed out and the scanner moves on.
- **Scenario 2:** You set the minimum at -30dBFS. A signal is found but it is at -31dBFS so the scanner skips it. In the next millisecond the signal jumps up to -25dBFS but it is too late; the scanner has moved on.

In each of these scenarios a minimum of around -35dBFS would have given more reliable results. It may take some trial and error for you to determine the "typical" signal strength variations in your location.

Take care not to set your minimum so that it is in the "noise floor"; doing so will cause the scanner to stop on static "noise" and it will never move on.

Radio Settle Time in Milliseconds

This control sets the sensitivity as a balance between speed and reliability. The way this works is:

1. The scanner asks SDR# to set the VFO frequency to a specific frequency.
2. The scanner software asks SDR# for a copy of the spectrum data containing the new frequency range.

3. The software searches that data for frequencies higher than the current one, and finds an active frequency.
4. The software compares the signal strength of the found frequency against the value set in the Minimum Signal Strength.
5. If the signal strength is greater than the minimum, the scanner tells SDR# to tune to that frequency.
6. After arrival on the new frequency, the scanner checks the frequency again to make sure its signal strength is still greater than the minimum.

The problem in step 6 is that the scanner measured the signal strength *right now* in step 4; and because the scanner is so fast, “right now” could mean that it measures the signal strength before the radio has actually tuned to the target frequency! SDR# can’t confirm to us that the radio actually tuned to the requested frequency so we have no way of knowing when we have a valid signal. So, the scanner has a flexible delay mechanism to prevent prematurely deciding the frequency is not active.

Radio Settle Time is arbitrarily divided by 20 to define the maximum number of times we will measure the frequency strength before giving up and moving on. For example, a Radio Settle Time of 500 means that the scanner will try a maximum of 25 times, with a short delay between each try. Most of the time (on my equipment) the scanner has to try only 0 to 9 times before confirming that the frequency is active. If the frequency is never active, the maximum delay would be (in this example) 500 milliseconds after which the scanner resumes scanning.

Smaller Radio Settle Time values improve the scanning speed at the risk of missing active frequencies because the scanner didn’t wait for the radio to tune; larger values mean a longer pause before confirming the signal strength but that sacrifices scanning speed. You need to set this at the lowest value possible for reliable signal detection to give you a balance between speed and reliability. It may take time and testing for you to decide on the best setting.

Recommended Process for Performance Tuning

You should follow this process for getting the most speed and reliability from the scanner:

1. Build a Group of known active frequencies that you can depend upon to start and stop transmitting so that you can exercise the signal measurement and decision-making processes.
2. Open the Scanner Decisions plugin so that you may monitor scanner activity.
3. Start a Group scan using a value of 500 for Radio Settle Time and with a Minimum Signal Strength set low enough to successfully detect the frequencies in your Group when they are active.
4. If the scanner reliably stops on frequencies that meet the Minimum Signal Strength, you can stop the scanner and reduce the Radio Settle Time value. If the scanner doesn’t stop reliably, increase that value.
5. Scan the Group again.
6. Repeat steps 4 and 5 until you get fast but reliable scans. If you see active frequencies being skipped (and they aren’t marked to be Ignored), then the Radio Settle Time is too low.

You won’t get both fast and reliable performance on your first try; for the best results you should determine what appears to be reliable, observe it for an hour or so to confirm that fact, and then re-tune the settings, if necessary, until frequency detection is reliable in the long term.

Benchmarking the Scanner

I don’t recommend trying to benchmark the scanner until you have it tuned for the best performance on your equipment. Of course, you can turn everything to its fastest setting but that won’t give a fair or accurate measurement.

You can benchmark both Group and Range scanning. To perform either benchmark:

1. Open the Preferences window and check Enable Speed Benchmark on the Scanner Performance tab.
2. Select Hi Resolution or Low Resolution in the Preferences window on the Scanner Performance tab. Low Resolution will result in faster scanning but will skip frequencies in the process. Close the Preferences window.
3. Stop all unnecessary software running on the computer. You want to give the benchmark a fair opportunity for speed, so exit any media software, other copies of SDR# or other radio software, etc. – basically anything that uses enough CPU that it could negatively impact SDR# performance.
4. Using the SDR# Source plugin, set the radio's Gain to zero.
5. The benchmark utility automatically sets the scan range from 55MHz to 2.2GHz.
6. You will note that the Minimum Signal Strength has been pre-set to zero and the squelch to 100. This is so that the scanner doesn't get stopped during the benchmark by an active frequency.
7. Put the frequency cursor in the spectrum window where you would typically have it during normal scanning. I find having the frequency cursor all the way to the left gives me the fastest scanning.
8. Click the Scan button. A warning box will open stating that the scanner has been configured for benchmarking. Click the OK button start the benchmark or Cancel to exit without benchmarking.
9. If you clicked OK the benchmark will start. It will run for about 10 seconds and will then display the resulting scanner speed. The scanner speed is placed on the Clipboard for your convenience. You can cancel the benchmark while it is running by clicking the Stop button.
10. I suggest running the benchmark at least 5 times and then taking the average result as your speed rating.
11. When you are finished, open the Preferences window and uncheck Enable Speed Benchmark on the Scanner Performance button.

When we do a benchmark nothing in the scanner is turned off or disabled in order to improve the scanning speed; other than the Minimum Signal Strength, the Squelch, and the RF Gain being set, there are no changes made to the scanner.

Notices

- "SDR#", "SDR#", "Airsy", and the SDR# software are Copyright © Youssef TOUIL 2012-2022.
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