

SATCOM Sim: User's Manual

v01.02

The screenshot displays the SATCOM Sim software interface, which is divided into several functional panels:

- Top Panel:** Includes menu options: MEASURE, MARKER, DISPLAY, VIEW / TRACE, ESCAPE. Below these are buttons for PRESET, FREQUENCY, SPAN, and AMPLITUDE, followed by an input field.
- Spectrum Analyzer (Left):** Shows a plot with a reference level of -60 dBm. The y-axis is labeled 'Peak Log 3 dBm' and ranges from -90 to -60. The x-axis shows frequency from 1070 MHz to 1080 MHz, with a center frequency of 1075 MHz and a span of 10 MHz. A yellow signal trace is visible.
- Demodulator (Center):** A green panel with the following settings:
 - Frequency: 1075 MHz, BER: $< 10^{-8}$
 - Bandwidth: 2 MHz
 - Mod Type: QPSK, Enable checked
 - FEC: 1/5
 - Buttons: Update, PLAY, PAUSE, CLEAR
- Antenna Settings (Right):**
 - Tx Antenna:** HPA Enable checked, Antenna Gain (dBm) 48, HPA (dBm) 55, BUC Freq (MHz) 12800.
 - Rx Antenna:** Antenna Gain (dBm) 48, LNA (dBm) 40, BDC Freq (MHz) 10750.
 - Satellite Antenna:** Share Satellite unchecked, None selected for Join Satellite, Antenna Gain (dBm) 44, HPA (dBm) 40, LNA (dBm) 35, TTF (MHz) 2300, Tx Center (MHz) 14125.
- Signal Configuration (Bottom):** Three panels for Signal 1, Signal 2, and Signal 3.
 - Signal 1:** Frequency 1325 MHz, Enable checked, Bandwidth 2 MHz, Data Rate 1.000000 Mbps, Power -30 dBm, Mod Type QPSK, FEC Rate 1/5, Random Data unchecked, Msg SATCOM Sim.
 - Signal 2:** Frequency 1325 MHz, Enable unchecked, Bandwidth 2 MHz, Data Rate 2 Mbps, Power -30 dBm, Mod Type BPSK, FEC Rate 1/5, Random Data unchecked, Msg.
 - Signal 3:** Frequency 1325 MHz, Enable unchecked, Bandwidth 2 MHz, Data Rate 2 Mbps, Power -30 dBm, Mod Type BPSK, FEC Rate 1/5, Random Data unchecked, Msg.

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II. Access SATCOM Sim

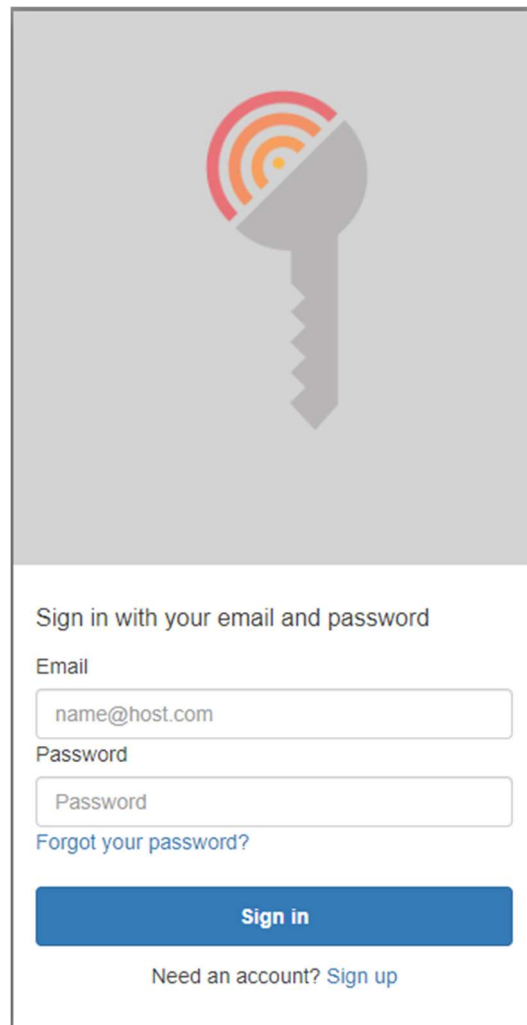
- a. Website

SATCOM Sim can be accessed at the following website:

<https://satcomsim.dawnkeysoftware.com/>

- b. Sign Up

A user must first sign up for an account to access the simulator.



Sign in with your email and password

Email

Password

[Forgot your password?](#)

Sign in

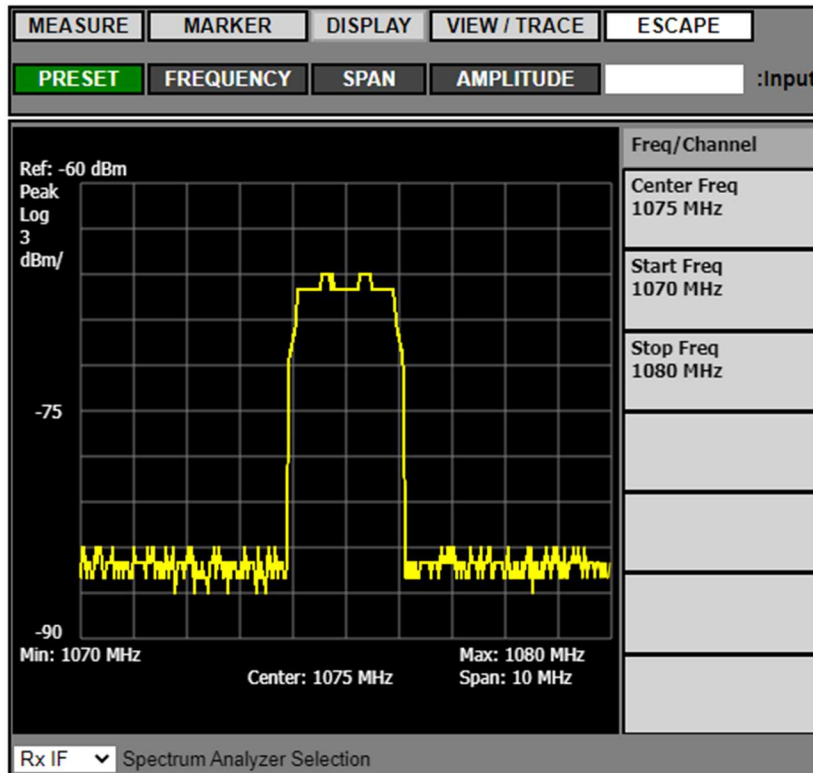
Need an account? [Sign up](#)

Click “Sign up” at the bottom, and provide an e-mail address and password. You will be required to verify your e-mail address. An e-mail will be sent to the e-mail address provided with a verification code. Be sure to check your Junk e-mail if it appears that you did not receive a verification e-mail.

c. Sign In

A user can then sign in once the account has been setup and verified. Signing in will immediately take the user to the SATCOM Sim WebApp simulation.

III. Spectrum Analyzer



d. Input

Input the number as text in the “Input” field. :Input

When the value has been entered the user will then be asked to set the Units

Freq/Channel
GHz
MHz
kHz

e. Center Frequency

FREQUENCY

The Center Frequency is the center of the X-Axis on the Spectrum Analyzer grid. To change the frequency the user should press the “FREQUENCY” Button.

The user has three options to set the center frequency on the Spectrum Analyzer Menu.

Freq/Channel
Center Freq 1075 MHz
Start Freq 1070 MHz
Stop Freq 1080 MHz

Choosing the “Center Freq” option gives the user the ability to directly set the center frequency in one step. The user could also set the left most bound (“Start Freq”) and the right most bound (“Stop Freq”). This is a two-step process to get the frequency range on the Spectrum Analyzer to the desired settings.

f. Span

SPAN

The span sets the frequency range of the Spectrum Analyzer. It lets the user decide how much bandwidth should be displayed on the Spectrum Analyzer grid. To change the span the user should press the “SPAN” button.

The user has three options to set the center frequency on the Spectrum Analyzer Menu.

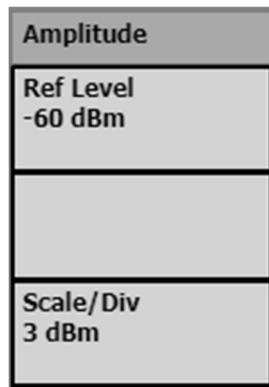
Span
Span 10 MHz

g. Amplitude

AMPLITUDE

The amplitude sets the power range of the Spectrum Analyzer. Power is the Y-Axis on the Spectrum Analyzer grid. To change the power range the user should press the “AMPLITUDE” button.

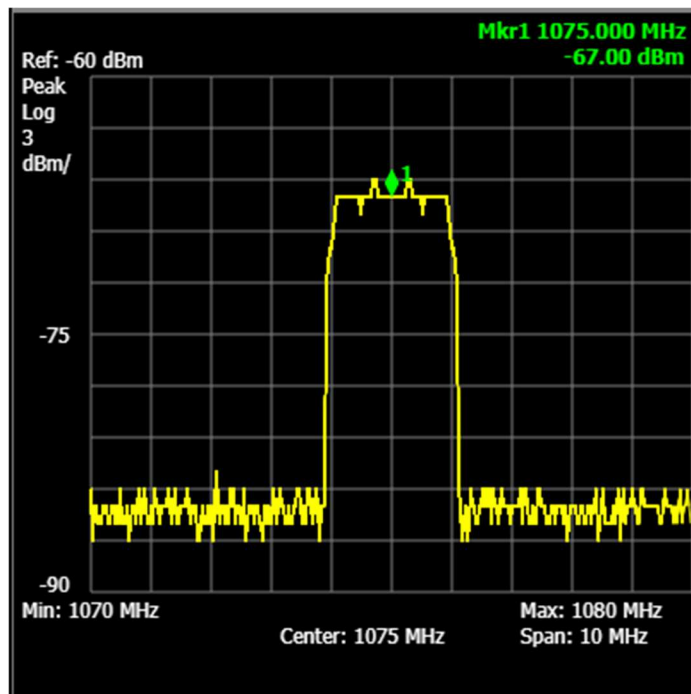
The user has two options to control amplitude setting on the Spectrum Analyzer grid. “Ref Level” allows the user to select the highest power that the Spectrum Analyzer grid to show, the top of the Y-Axis. The “Scale/Division” allows the user to set how much power each tick mark represents.



h. Markers

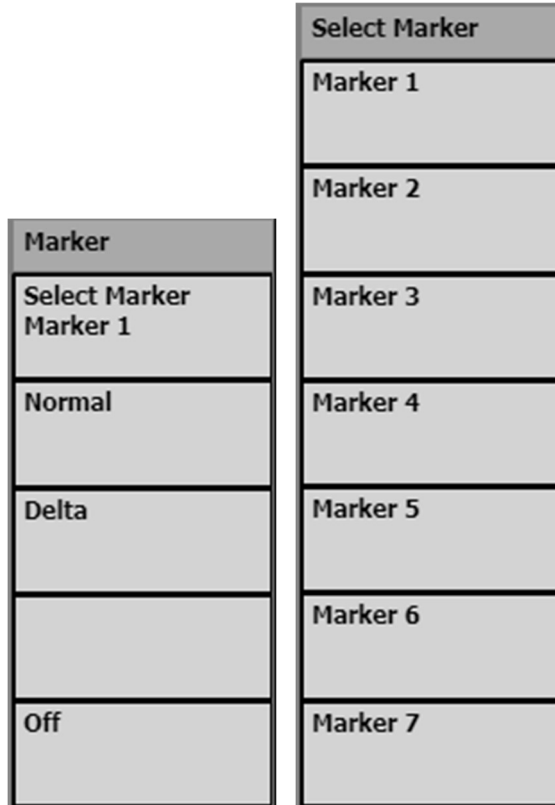
MARKER

The “MARKER” Button gives the user options to place a marker on the grid.

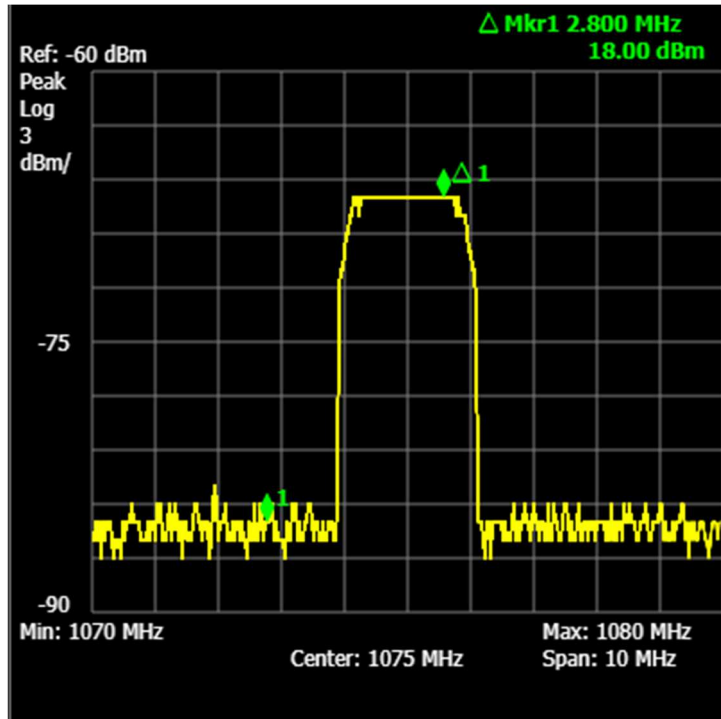


The top right corner of the screen will then display the frequency and power at that marker position. The user can change the marker position by clicking the place on the grid where the marker is desired to be.

Three options are provided to the user when the “MARKER” button is selected.



- i. **Select Marker**
The “Select Marker” option allows the user to select which Marker settings are to be changed. The user can have up to seven active markers at a time.
- ii. **Normal**
Once the user selects a marker it can be activated on the grid by selecting “Normal” in the menu.
- iii. **Off**
The marker can be removed from the grid by selecting “Off”.
- iv. **Delta**
The “Delta” option will activate a second marker that is directly related to the Active Marker. The second marker is the “Delta Marker”. The user can then click anywhere on the grid to place the Delta Marker. The top right hand of the Spectrum Analyzer will then show the user the difference in frequency and power between the Active Marker and the Delta Marker.

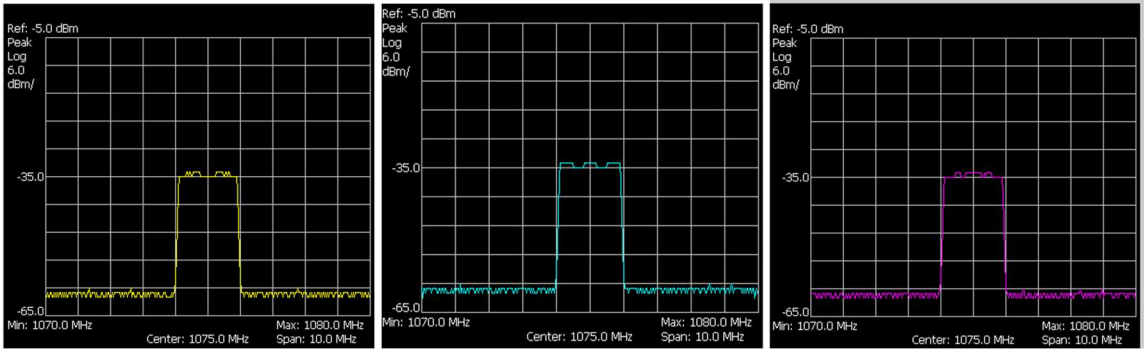


i. View/Trace

VIEW / TRACE The “VIEW/TRACE” button gives the user options to place additional frequency/power traces on the grid. Each trace has a different color, and multiple options which information the trace should display.

Select Trace
Trace 1
Trace 2
Trace 3

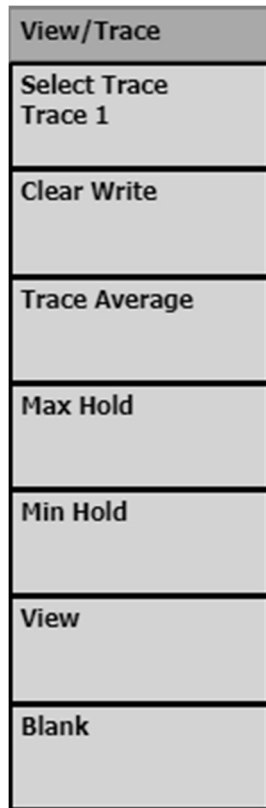
The user can choose up to three different traces.



Trace 1 is yellow

Trace 2 is cyan.

Trace 3 is magenta

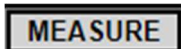


There are seven different options for View/Trace.

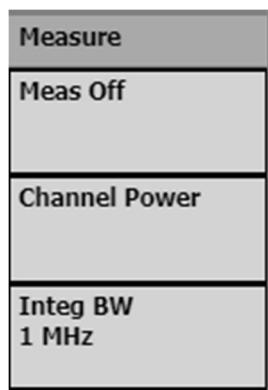
- i. **Select Trace**
The "Select Trace" option allows the user to select the Trace to modify.
- ii. **Clear Write**
Selecting "Clear Write" enables the trace to be displayed in the Spectrum Analyzer grid. The trace will show live, unmodified, modified frequency and power being measured. No other "View/Trace" options can be selected until "Clear Write" has been selected first.

- iii. Trace Average
When “Trace Average” is selected, the trace will begin taking average power reading of each frequency point over time and updating the Spectrum Analyzer grid as the average values change. “Clear Write” must be selected first in order to use this option.
- iv. Max Hold
When “Max Hold” is selected, the trace will begin reading the power of each frequency point over time and updating the Spectrum Analyzer grid when a new higher value is measured. The trace will show the maximum power measured at each frequency point since the moment “Max Hold” was selected. “Clear Write” must be selected first in order to use this option.
- v. Min Hold
When “Min Hold” is selected, the trace will begin reading the power of each frequency point over time and updating the Spectrum Analyzer grid when a new lower value is measured. The trace will show the minimum power measured at each frequency point since the moment “Min Hold” was selected. “Clear Write” must be selected first in order to use this option.
- vi. View
The “View” option pauses each pixel in the grid at the moment the “View” button is selected. “Clear Write” must be selected first in order to use this option.
- vii. Blank
Selecting “Blank” will remove that trace from the grid and no longer show any updates for that Trace.

j. Measure

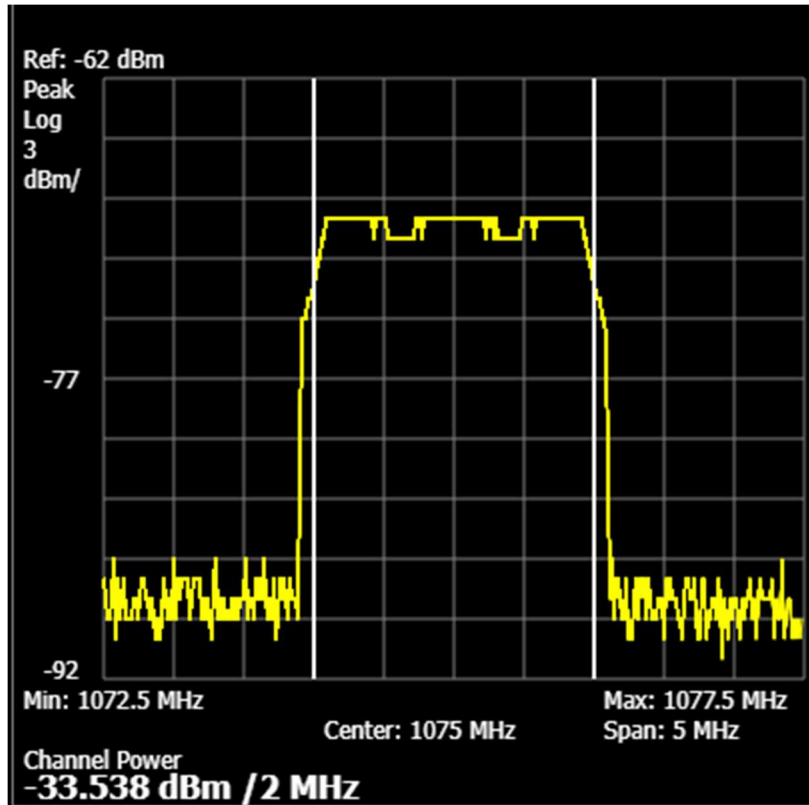


The Measure button gives the user additional options to measure frequency and power data on the Spectrum Analyzer.



i. Channel Power

The “Channel Power” option gives the user the ability to measure the total power in a selected frequency range in units of dBm/MHz. The channel power is displayed in the lower left-hand corner of the display when activated.



ii. Integ BW

The “Integ BW” option gives the user the ability to set the integrated bandwidth. This allows the user to select over which frequency range to calculate the power. White lines appear on the grid to indicate the integrated bandwidth range that was chosen.

k. Spectrum Analyzer Selection



The Spectrum Analyzer Selection combo box gives the user options to analyze different points in the signal path. Each Spectrum Analyzer has its own settings and will be saved if they are changed when switching between different options.

i. Rx IF

The Rx IF shows the signal at the receive path’s intermediate frequency immediately after down conversion of the signal.

- ii. Tx IF
The Tx IF shows the signal at the transmit path’s intermediate frequency. This is directly out of the signal generator and immediately prior to up conversion of the signal.
- iii. Tx HPA
The Tx HPA shows the signal at the transmit path immediately after up conversion of the signal. This input to the Spectrum Analyzer is reduced by 30 dB similar to how a real HPA would have a coupler as an output to a Spectrum Analyzer.

IV. Modulator

The modulator allows the user to set the signal settings for each signal being transmitted. This simulator has six modulators. They are labeled “Signal 1” through “Signal 6.”

The image shows a screenshot of a software interface for configuring two signals, Signal 1 and Signal 2. Each signal configuration panel includes the following fields and controls:

- Signal 1:**
 - Frequency: 1325 MHz (checked Enable)
 - Bandwidth: 2 MHz
 - Data Rate: 1.000000 Mbps (Switch button)
 - Power: -30 dBm (SWEEP/HOP button)
 - Mod Type: QPSK
 - FEC Rate: 1/4 (Random Data checkbox)
 - Msg: SATCOM Sim
- Signal 2:**
 - Frequency: 1325 MHz (unchecked Enable)
 - Bandwidth: 2 MHz
 - Data Rate: 2 Mbps (Switch button)
 - Power: -30 dBm (SWEEP/HOP button)
 - Mod Type: BPSK
 - FEC Rate: 1/4 (Random Data checkbox)
 - Msg: (empty)

a. Frequency

The “Frequency” text box represents the target center frequency for the signal being transmitted. There is a dropdown box next to the text field to select the desired units (GHz, MHz, kHz, Hz).

b. Bandwidth and Data Rate

The Bandwidth text box represents the target bandwidth of the signal being transmitted. There is a dropdown box next to the text field to select the desired units (GHz, MHz, kHz, Hz). The user can press the “Switch” button to switch the option to edit “Data Rate” instead of bandwidth. The target signal bandwidth will then be auto-generated based on the target Data Rate, Modulation Type, and Forward Error Correction (FEC) settings. The bandwidth will be automatically updated when the Mod Type or FEC is changed when the switch is set to edit the Data Rate. The Bandwidth will not automatically change when Mod Type or FEC is changed when the switch is set to Bandwidth.

c. Power

The “Power” text box represents the target power for the signal being transmitted. This value is only in units of dBm.

d. Mod Type

The “Mod Type” dropdown box represents the target modulation type for the signal being transmitted. The dropdown box has options for BPSK, QPSK, 8PSK, or CW. The “CW” is a Carrier Wave. This is a signal frequency with no bandwidth and no modulation capabilities.

e. FEC

The “FEC” dropdown represents the target forward error correction type for the signal being transmitted. The dropdown box has options for “None” or “1/4”. No forward error correction is applied to the data being sent when “None” is selected. The “1/4” FEC setting uses a very simple forward error correction for this simulation. It just sends four copies of each data bit that is sent.

f. Msg

The “Msg” text box can be populated with any text data the user desires to enter. This text will then be broken down into bits and become the simulated data being transmitted. This simulator’s demodulator can be set up to read the signal and properly decode the data that was sent on that signal. The user can also click the “Random Data” check box in order to send a series of random characters as a data.

g. Enable

Checking the “Enable” box will immediately activate the signal and begin the simulation of transmitting the signal based on the input settings provided.

h. Update

The user must press the “Update” button in order to get any Modulator settings to actually update for the transmitted signal. Any settings are just in “Draft” Mode until “Update” is pressed. Pressing the “Enter” key on the keyboard after editing a text field will also trigger the settings update. The “Update” button will turn pink when the modulator settings are in a draft state. This allows the user a visual confirmation that the settings for the signal did indeed update.



i. Sweep / Hop



The “SWEEP / HOP” button allows the user to create a more advanced transmit setting for a signal that constantly changes its center frequency based on additional settings. A Sweep/Hop settings section will appear when the button is pressed.

Sweep/Hop 1 Sweep Hop None

Update Fast Slow

i. None

Selecting “None” will set the system to have no Sweep or Hop activities

ii. Dwell Time

The Dwell time indicates how long the signal should stay in one place after it moves. The options are Fast or Slow.

iii. Sweep

The Sweep setting is used to transmit a signal that moves between a left and right frequency boundary. “Minimum Frequency” sets the left bound frequency. “Maximum Frequency” sets the right bound frequency. “Step Size” indicates how far the signal should move for each step as it transitions between the minimum and maximum frequency.

Sweep/Hop 1 Sweep Hop None

Update Fast Slow

Step Size (MHz):

Min Freq (MHz): Max Freq (MHz):

iv. Hop

The Hop setting is used to transmit a signal that moves to a series of explicitly defined center frequencies. The user can setup a maximum of 8 center frequencies for the modulator to “hop” through.

Sweep/Hop 1 Sweep Hop None

Update Fast Slow

Hop Signals: ▼

Freq 1 (MHz): Freq 2 (MHz):

Freq 3 (MHz): Freq 4 (MHz):

Freq 5 (MHz): Freq 6 (MHz):

Freq 7 (MHz): Freq 8 (MHz):

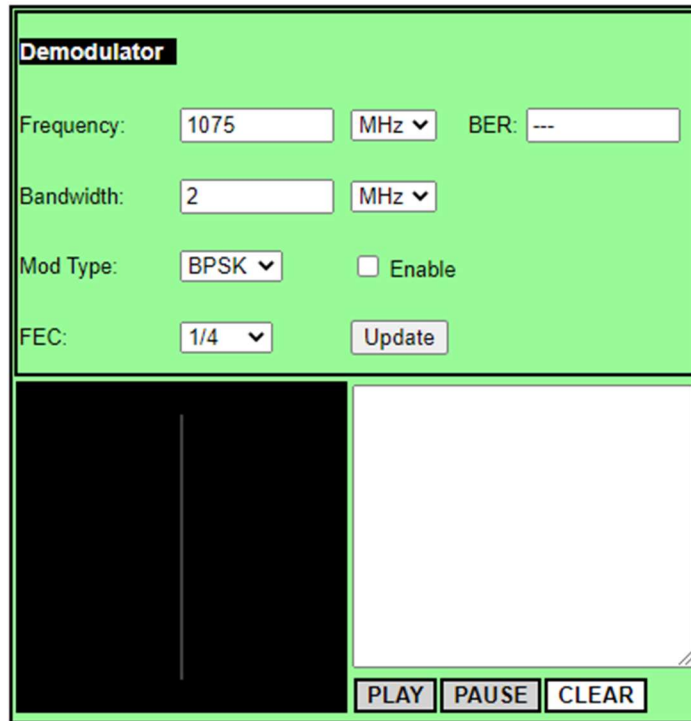
v. Update

The “Update” button locks in the user settings for the Sweep/Hop function. The Sweep/Hop button will then turn green if either Sweep or Hop was set up.



V. Demodulator

The demodulator allows the user to receive a signal and display the message it receives. There is also an I/Q Plot of the desired signal.



a. Frequency

The “Frequency” text box represents the target center frequency for the signal being received. There is a dropdown box next to the text field to select the desired units (GHz, MHz, kHz, Hz).

b. Bandwidth and Data Rate

The Bandwidth text box represents the target bandwidth of the signal being received. There is a dropdown box next to the text field to select the desired units (GHz, MHz, kHz, Hz).

c. Mod Type

The “Mod Type” dropdown box represents the target modulation type for the signal being received. The dropdown box has options for BPSK, QPSK, or 8PSK.

d. FEC

The “FEC” dropdown represents the target forward error correction type for the signal being received. The dropdown box has options for “None” or “1/4”. No forward error correction is applied to the data being received when “None” is selected. The “1/4” FEC setting uses a very

simple forward error correction for this simulation. It expects four copies of each data bit that is received and keeps whichever bit has more instances.

e. Enable

Checking the “Enable” box will immediately activate the demodulator and begin the simulation of receiving the signal based on the input settings provided.

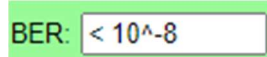
f. Update

The user must press the “Update” button in order to get any Demodulator settings to actually update for the received signal. Any settings are in “Draft” Mode until “Update” is pressed. Pressing the “Enter” key on the keyboard after editing a text field will also trigger the settings update. The “Update” button will turn pink when the demodulator settings are in a draft state. This allows the user a visual confirmation that the settings for the demodulator did indeed update.



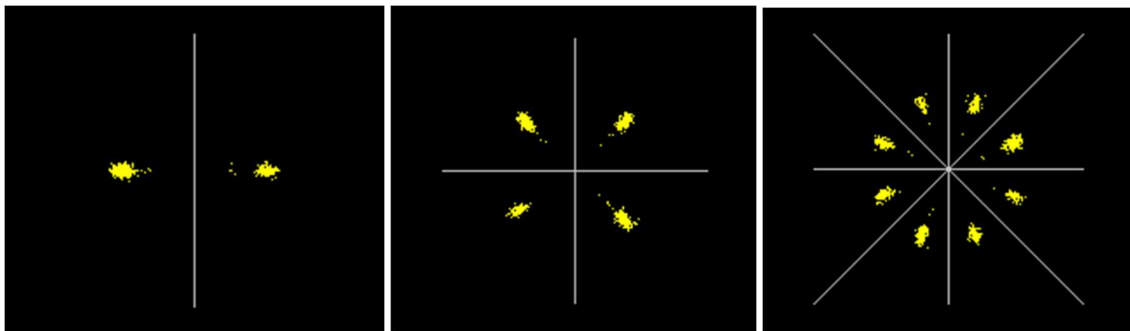
g. BER

The “BER” field shows the current Bit Error Rate of the received signal. This field will only update if the FEC is set to “1/4”. If the bit error rate gets below the 10^{-4} the BER field will show “---”. The error rate is sufficiently high at this point that the data read is unreliable.



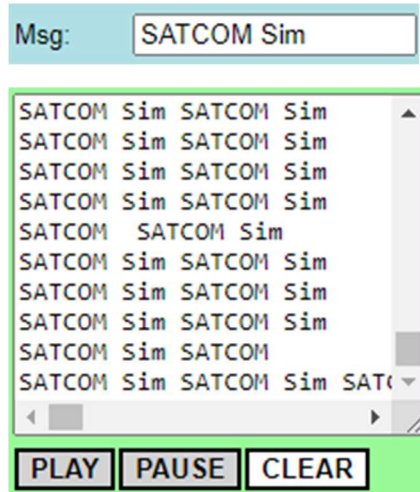
h. I/Q Plot

The I/Q Plot shows the measured phase angles of each frequency based on the demodulator settings.



i. Message

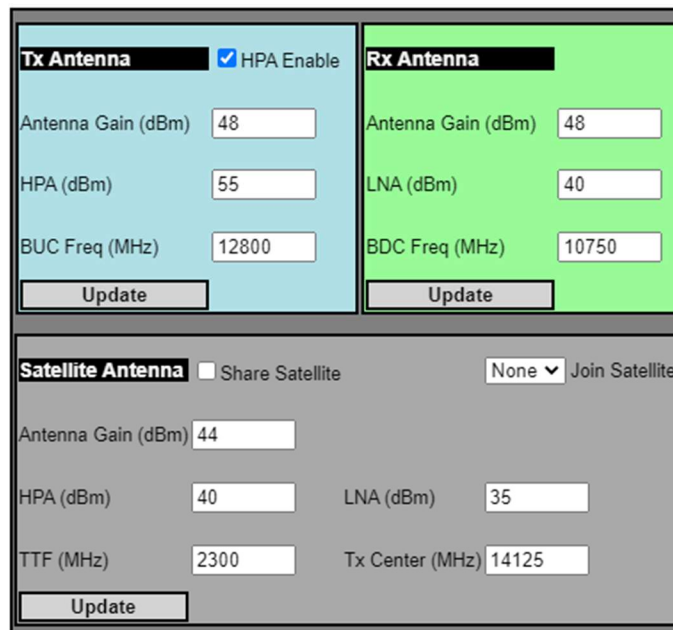
The Demodulator can also display the text message that is received. If the demodulator is setup to match the Modulator settings then the message being sent by the transmitter will be continuously displayed in the Demodulators message window.



The demodulator’s text window also has options to Pause and Play the continuous stream of text being displayed in the window. The user can also press “Clear” to clear out all of the data that is already displayed in the text area.

VI. Antenna Setup

The antenna setup area is intended to setup the gain values for each available antenna. Each modulator and demodulator has its own antenna associated with it. They are color coded to easily see which antenna belongs to which control system. There is also a setup for the settings of the satellite the simulation is communicating through.



a. Transmit Antennas

The antenna labeled Tx Antenna is intended to represent the settings for the antenna attached to the 6 transmit signals available to the user. The “HPA Enable” check box allows turns the HPA on or off. If this box is not checked then the signal will not be amplified and will not proceed to the satellite. The text field labeled “Antenna Gain” is intended to represent the gain of the antenna itself. The “HPA” field represents all of the amplification provided by the transmit system between the Modulator and the Antenna. The “BUC Freq” field represents the center frequency of the Block Up-Converter in MHz. When the signal is up-converted the center frequency of the Modulator is increased by the center frequency of the Block Up-Converter. This is up-converted frequency is the frequency of the signal as it travels to the satellite.

b. Receive Antenna

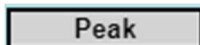
The receive antenna is labeled “Rx Antenna”. The receive antenna receives the data that goes to the demodulator. The text field labeled “Antenna Gain” is intended to represent the gain of the antenna itself. The “LNA” field represents all of the amplification provided by the receive system between the Demodulator and the Antenna. The “BDC Freq” field represents the center frequency of the Block Down-Converter in MHz. When the signal is down-converted the center frequency of the received signal from the satellite is decreased by the center frequency of the Block Down-Converter. This is down-converted frequency is the frequency of the signal as it travels to the demodulator.

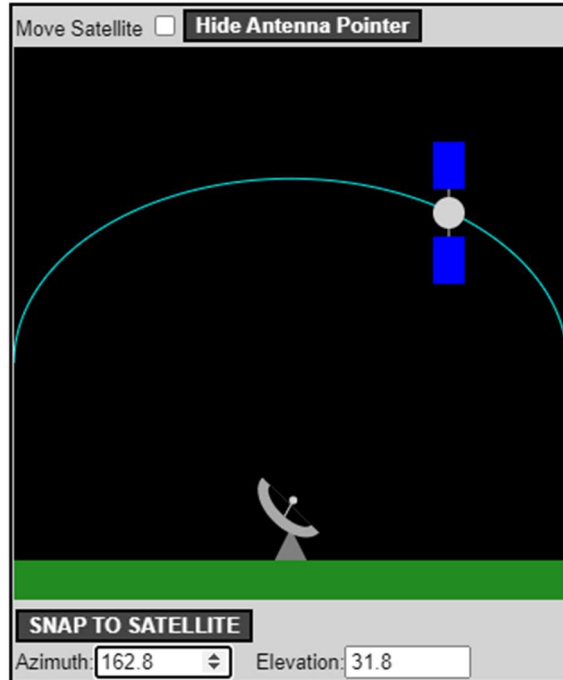
c. Satellite

The satellite simulation is intended to represent a “bent pipe” satellite system with a single antenna. The text field labeled “Antenna Gain” is intended to represent the gain of this antenna. The “LNA” field represents all of the amplification provided by the receive system on the satellite. The “HPA” field represents all of the amplification provided by the transmit system on the satellite. The “TTF” field represents the Transponder Translation Frequency of the satellite. The frequency of the signal that is received by the satellite is reduced by the TTF frequency prior to being transmitted back down to the earth. The field labeled “Tx Center Freq” represents the center of the transponder bandwidth. This satellite simulation supports a transponder bandwidth of 40 MHz.

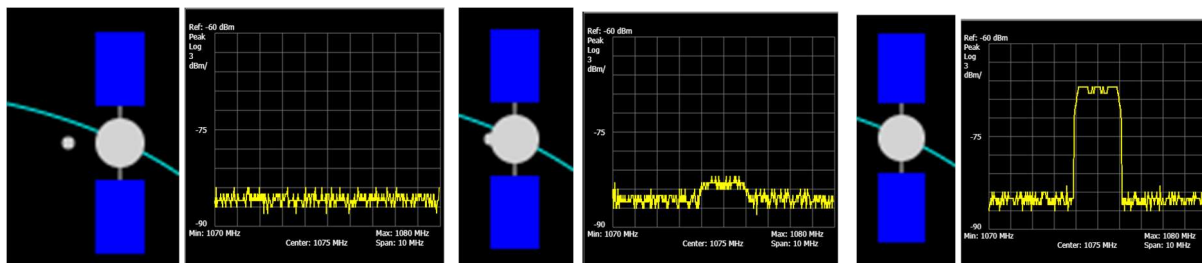
d. Antenna Pointer

The Antenna Pointer can be used to simulate peaking on a satellite. This simulation simultaneously controls peaking on the satellite with both the Transmit and Receive antennas. Clicking the “Peak” button on the Transmit antenna interface will bring up the antenna pointing simulation.





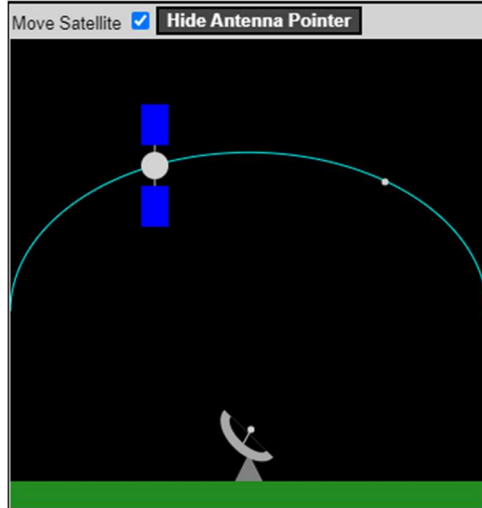
- i. **Change Antenna Pointing Target**
 The “Azimuth” and “Elevation” inputs allow the user to change the antenna target. There is a small “target sphere” that the user can use to visualize how close they are to the satellite. As the user gets closer to the satellite the target sphere will no longer be visible and the user will have to use power reading from the Spectrum Analyzer to ensure accuracy of the pointing angles. The simulation does simulate side lobes of power. The user will have to ensure they point to the main lobe’s power to maximize efficiency of the signal lock.



- ii. **Snap to Satellite**
 The “SNAP TO SATELLITE” button allows the user to immediately move the antenna pointing angles to be accurately targeting the satellite. **SNAP TO SATELLITE**

iii. Move Satellite

The user can move the satellite's position on the orbit. The user must check the box to move the satellite. Then clicking on the new orbit location will cause the satellite to move to the new location.



iv. Hide Antenna Pointer

Clicking "Hide Antenna Pointer" button will remove the antenna pointer simulation from the user's view.

VII. When "Trace Shared Simulation Network Connections

SATCOM Sim supports multiple users connecting to each other over an internet connection. Each user can then transmit through the same satellite and see and interact with each other's signals. A user will only be able to share or join a connection with other users that are connected to the same server. If you are expecting to see a certain user available to join with and they are not in the list then it is likely you are connected to a different internal server than that user.



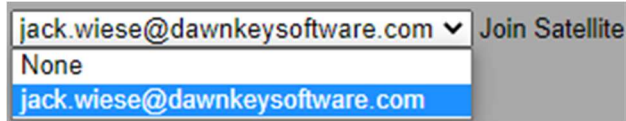
a. Share Satellite

One user needs to "share" their satellite for others to see and join with that simulation. Checking the "Share Satellite" box sends information to all of the other users on the server that your server is available to be joined by others.



b. Join Satellite

If there are already available user satellite's to join they will be populated in the "Join Satellite" drop down box. Selecting a user's e-mail address will allow your connection to be joined with their simulation

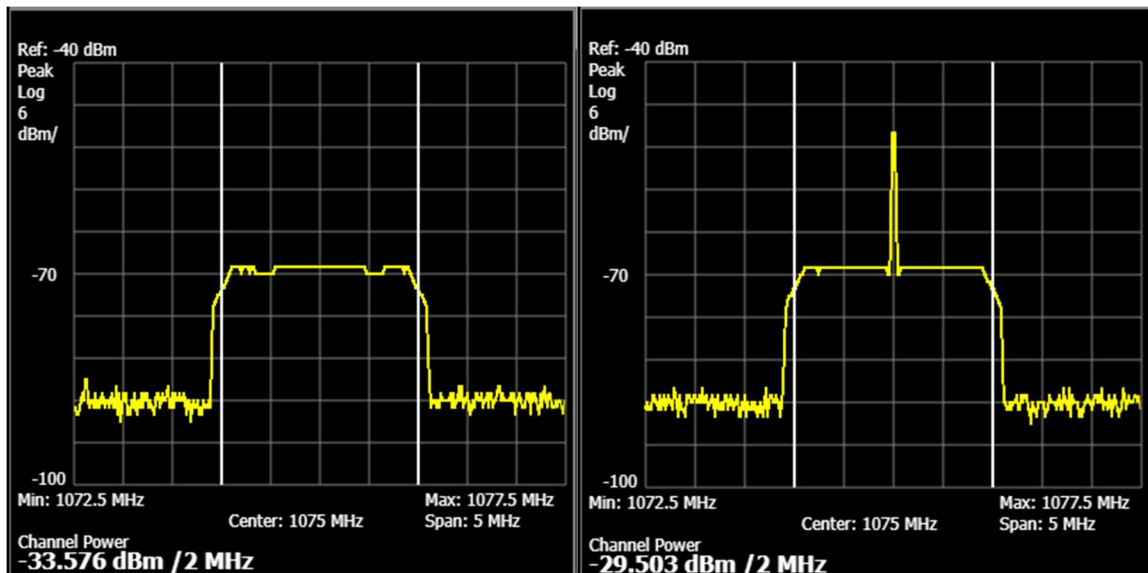


VIII. Interference Simulations

SATCOM Sim can also accurately simulate what happens to a signal when there is another signal interfering with it.

a. Spectrum Analyzer

The Spectrum Analyzer will update appropriately when two signals are being transmitted on the same frequency. The first picture shows a signal with a channel power measurement. The second picture shows channel power measurement over the same bandwidth, but a carrier wave is causing interference.



b. I/Q Plot

The first picture shows a BPSK signal with no interference. The second picture shows that BPSK signal receiving interference from a QPSK signal. The third signal shows that BPSK signal receiving interference from an 8PSK Signal. The interference is being simulated using any other signal from the Local or Remote Modulator.

