The Windfreak Technologies SynthHD is a RF Signal Generator with a lot of features, some simple and some more complex. In general, the software GUI provided with the hardware makes it very easy for a user to control the basic features of the hardware.

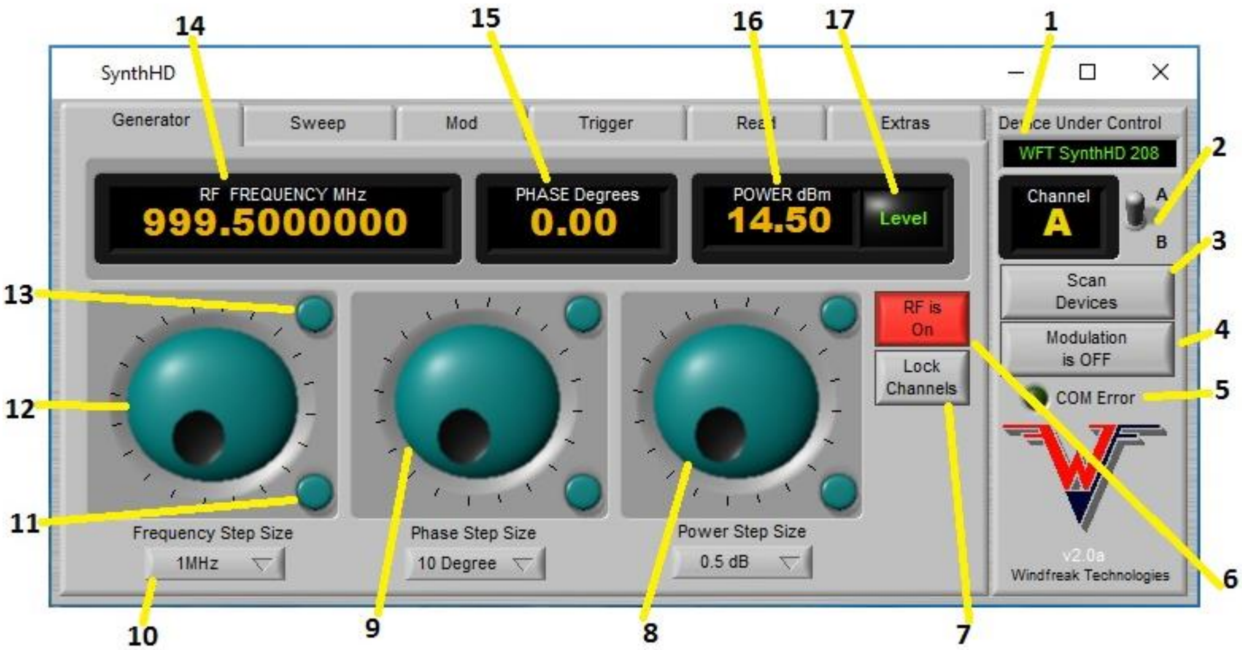


Figure 1 – Generator Tab

The **Generator Tab** (figure 1) is the main place to conduct frequency, phase, and amplitude adjustments.

1. **Device Under Control.** When first loaded, the SynthHD GUI will attempt to find SynthHD hardware plugged in via USB. If a device is detected, it will display here and show the serial number for that device. If it finds more than 1 device, the software will ask you which device you want to control. If using many devices, it is a good idea to mark the cases with their serial numbers.
2. **Channel Selector.** The SynthHD is a dual channel device. Use the Channel Selector to choose which channel you want to control. Channel A controls RFoutA marked on the SynthHD case. Channel B controls RFoutB marked on the SynthHD case.
3. **Scan Devices.** This button will scan for new devices if you have plugged or unplugged SynthHDs. In general, the software will release the COM port if nothing is going on with the GUI. This allows you to plug and unplug without shutting down the GUI. When you click Scan Devices, all the variables from the hardware will load into the GUI. Also, every time you change channels, all the

variables are swapped through USB. Otherwise the GUI will be out of sync with newly added hardware. Once you power down a SynthHD and re-power the device, it loads all the variables from a internal nonvolatile memory, not from the software that is open. This also requires clicking Scan Devices to get the software back in sync with the hardware.

4. **Modulation Monitor.** This is partially a control, but mostly a display. The SynthHD can simultaneously have multiple modulations on at once. If you have plugged in a SynthHD that has modulation turned on as a memory preset, this button will be lit (after GUI sync) showing that the device has modulations turned on. When lit, this button can be clicked to turn off all modulations at once. It will not turn on modulation. This should be done from the Mod Tab.
5. **Com Error.** This is an indicator showing that there are USB communications errors. All attempts are made to clear errors in the software and hardware when these occur, but this doesn't always work with all computers. If you have tried to control a device when none are plugged in, it could cause problems that may require restarting the GUI or restarting the PC.
6. **RF On / OFF.** This button turns the RF completely on and off by disabling the PLL chip and RF output amplifiers in the SynthHD for the channel selected. It is recommended that you keep any unused channel turned off since there is RF leakage between channels. Each channel also uses about 2 watts of DC power which generates heat. This button will reduce that to almost zero for the given disabled channel.
7. **Lock Channels.** This button will lock the amplitudes and frequencies of the two channels. Set up each channel with the desired amplitude and frequency. Then click the Lock Channels button and adjust the amplitude or frequency of one and both will change keeping the same differential frequency and amplitude spacing. Be sure and unlock the channels after use, as leaving it locked when not using can get very confusing.
8. **Power Knob.** Dial the RF power knob to change the amplitude of the signal. Occasionally after changing channels, the knob may not change anything on the first click. This is normal as the software resyncs to the new channel.
9. **Phase Knob.** Dial the Phase knob to change the relative phase between the two channels. For version 1.0x firmware phase between channels always starts as an unknown. It is up to the user to determine the absolute phase. To normalize, adjust the phase with the knob to the desired differential value (via measurement) then click inside the Phase Degrees display (#15) and enter zero. At this point the two phases are calibrated and dialing new phases to one channel can be trusted. For now, any time frequency is changed on either channel, the phase between the two is altered to another unknown state and manual readjustment needs to be performed again. (Certain features inside the PLL chip concerning phase currently do not work, but WFT engineering hopes to find a firmware solution soon.)
10. **Step Size.** Frequency, Amplitude and Phase all have step size adjustment dropdown boxes to adjust the resolution of the knobs. Select the proper step size for your application.
11. **Step Down.** Frequency, Amplitude and Phase all have round buttons to the right

of each knob that will increment or decrement by one step size for fine tuning.

12. **Frequency Knob.** Dial the Frequency knob to change the frequency of the signal.
13. **Step Up.** Frequency, Amplitude and Phase all have round buttons to the right of each knob that will increment or decrement by one step size for fine tuning.
14. **Frequency Display.** Click in the display and type in the frequency (in MHz) with your keyboard.
15. **Phase Display.** Click in the display and type in the phase (in degrees) from your keyboard. If desired, adjust the phase then enter in zero to make easy jumps to other phases.
16. **Power Display.** Click in the display and type in the amplitude (in dBm) from your keyboard.
17. **Leveled Display.** Shows "Level" if the calibration routine is properly calibrating the output level. Will show "Unlevel" if at the ends of the output power capability, either high or low, at the given frequency.

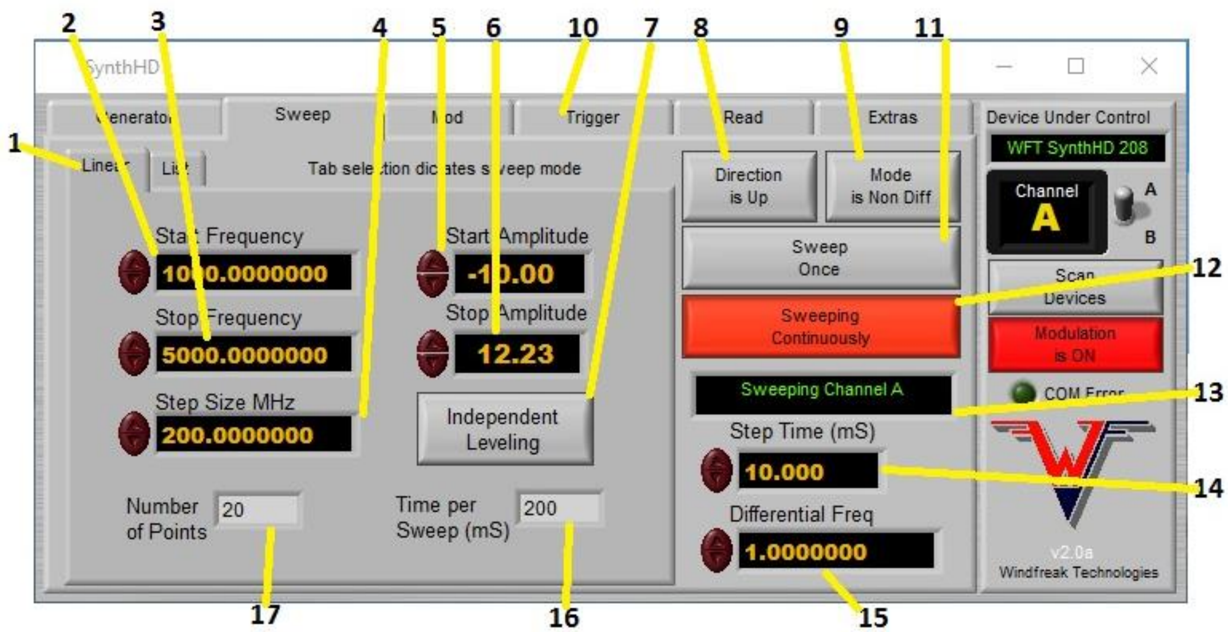


Figure 2 – Sweep Tab – Linear Sweep

The **Sweep Tab** (figure 2) is the place to set up sweeps. Sweeps can be either linear or come from a table.

1. **Sweep Type Tab.** Choose either Linear or List. List is explained in Figure 3. Sweep variables are stored in the SynthHD for each channel but the channels cannot be swept independently at the same time. Only a locked differential sweep is allowed with both channels.
2. **Start Frequency.** Click in the box and enter the starting (lower) frequency with your keyboard. Frequency is in MHz. Start frequency is always less than stop

frequency.

3. **Stop Frequency.** Click in the box and enter the stop (higher) frequency with your keyboard. Frequency is in MHz. Start frequency is always less than stop frequency.
4. **Step Size.** Click in the box and enter the step size in MHz with your keyboard. Step size is always positive.
5. **Start Amplitude.** This box is for the amplitude associated with the start (lower) frequency. During the sweep, amplitude will follow a line between the Start and Stop Amplitude settings.
6. **Stop Amplitude.** This box is for the amplitude associated with the stop (higher) frequency. During the sweep, amplitude will follow a line between the Start and Stop Amplitude settings.
7. **Independent Leveling.** When in “Independent Leveling Mode” the Start Amplitude and Stop Amplitude boxes can be edited and used for linearly sloped amplitude changes during sweep. Clicking this box switches to “Leveling from Main Power” control via the Generator Tab and the Amplitude Knob or Amplitude display entry box. While leveling from the main power control, the Start and Stop Amplitudes are set equally to the main power display setting.
8. **Direction is Up.** This button switches between sweeping up and sweeping down.
9. **Mode is Non-Differential**. Click this button to have a two channel sweep with a constant differential offset frequency. Sweep frequencies are controlled by channel A. The differential frequency is in MHz and can be negative to put channel B at a lower frequency than channel A. When doing a differential sweep, make sure both channels are turned on in the Generator Tab. Also each channel can have different leveling values as described in #5 and #6 above but enter similar start and stop frequencies for channel B to insure good calibration leveling.
10. **Trigger**. Click the dropdown box, which lets you select the 3 options that affect sweeping: No Triggers, Full Sweep Triggering and Single Sweep Step Triggering. *No Triggering* just means the GUI will start either a single sweep, or a continuous (repetitive) sweep. *Full Sweep triggering* means that pulling the Trigger SMA Connector center pin low will initiate a full sweep, then stop at the end. Another low going pulse on the Trigger Connector will again start another single sweep. If the Trigger Connector is held low, the sweep will run as if continuous software triggered sweep is on. *Step triggering* will control individual steps set up in the sweep. Pulling the Trigger Connector low will initiate a single step. The step time is a way of debouncing the trigger signal, but insure that you remove the low pulse before your step time is up or the sweep will continue to the next step. The trigger signal is level sensitive not edge sensitive.
11. **Sweep Once**. Use this button to initiate a single sweep.
12. **Sweep Continuously**. Use this button to turn on continuous repetitive sweeping.
13. **Sweeping Indicator**. Indicates a certain channel is sweeping. It’s possible to set up a sweep on one channel, then flip the channel control switch to adjust CW settings on another channel.

14. **Step Time**. Value in milliseconds for each step in a sweep.
15. **Differential Frequency**. When using Differential Mode sweeping, this is the frequency in MHz that separates the two channels as they sweep in lock step. Channel B = Channel A + Differential Frequency. This frequency can be negative, which puts channel B at a lower frequency than channel A.
16. **Time per Sweep**. Estimated time it will take to complete 1 whole sweep in mS.
17. **Number of Points**. Calculated number of steps in the sweep.

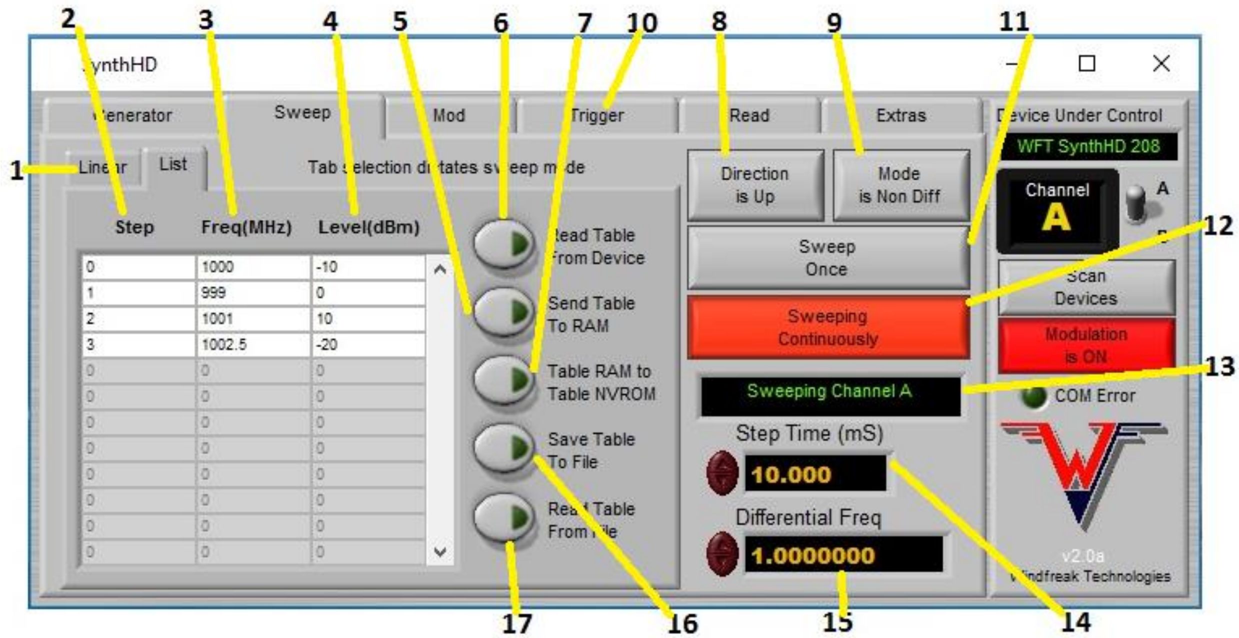


Figure 3 – Sweep Tab – List Sweep

1. **Sweep Type Tab.** Choose either Linear or List. Linear is explained in Figure 2. The table can be a total of 100 unique frequencies and amplitudes. List sweep acts almost exactly like linear sweep except it steps in arbitrary ways defined by the user. Right click on the table for advanced editing tools.
2. **Step.** This cell has to be populated for active frequency steps starting with zero. It dictates which position the line item is placed in SynthHD RAM. It's possible to skip a number and save the line item to the SynthHD, but the SynthHD will consider any step with a zero frequency value to be the end of the sweep. It's also possible to enter the steps out of order. When sending the table to SynthHD RAM, the SynthHD will put them in the proper order based on Step value.
3. **Frequency.** Populate this cell with the frequency in MHz of the step. Be sure and use only frequencies between 54MHz and 13.6GHz. The first frequency cell with a zero value is considered the end of the sweep, even if line items after it are populated.
4. **Amplitude.** Populate this cell with the desired CW amplitude in dBm for that frequency.
5. **Send Table to RAM.** Nothing is communicated to the SynthHD during editing of the table until this button is clicked. After clicking this button, the table is then

sent to SynthHD volatile memory (RAM) which will be reset during a power cycle event. At this point list sweeping can be performed.

6. **Read Table from Device.** Loads the table to the GUI through USB.
7. **Table RAM to Table NVROM.** Stores the table to nonvolatile memory, which is safe during power down. This allows you to run list sweeps without having a PC hooked up to the SynthHD. All other items on the SynthHD are saved to NVROM on the Extras Tab EXCEPT the Sweep Table (and AM waveform). Be sure and save it here.
8. **Direction is Up.** This button switches between stepping up and stepping down.
9. **Mode is Non-Differential**. Click this button to have a two channel sweep with a constant differential offset frequency. Sweep frequencies are controlled by channel A. The differential frequency is in MHz and can be negative to put channel B at a lower frequency than channel A. When doing a differential sweep, make sure both channels RF is turned on in the Generator Tab. Both channels get the same power settings from the table so some error will be introduced if the differential frequency separation is wide and if there is a large difference between calibration data between channels.
10. **Trigger**. Click the dropdown box, which lets you select the 3 options that affect sweeping: No Triggers, Full Sweep Triggering and Single Sweep Step Triggering. *No Triggering* just means the GUI will start either a single sweep, or a continuous (repetitive) sweep. *Full Sweep triggering* means that pulling the Trigger SMA Connector center pin low will initiate a full sweep, then stop at the end. Another low going pulse on the Trigger Connector will again start another single sweep. If the Trigger Connector is held low, the sweep will run as if continuous software triggered sweep is on. *Step triggering* will control individual steps set up in the sweep. Pulling the Trigger Connector low will initiate a single step. The step time is a way of debouncing the trigger signal, but insure that you remove the low pulse before your step time is up or the sweep will continue to the next step. The trigger signal is level sensitive not edge sensitive.
11. **Sweep Once**. Use this button to initiate a single sweep.
12. **Sweep Continuously**. Use this button to turn on continuous repetitive sweeping.
13. **Sweeping Indicator**. Indicates a certain channel is sweeping. It’s possible to set up a sweep on one channel, then flip the channel control switch to adjust CW settings on another channel.
14. **Step Time**. Value in milliseconds for each step in a sweep.
15. **Differential Frequency**. When using Differential Mode sweeping, this is the frequency in MHz that separates the two channels as they sweep in lock step. Channel B = Channel A + Differential Frequency. This frequency can be negative, which puts channel B at a lower frequency than channel A.
16. **Save Table to File.** Saves the table in text format to your PC. It is then possible to use other editors.
17. **Read Table from File.** Read saved tables from your PC.

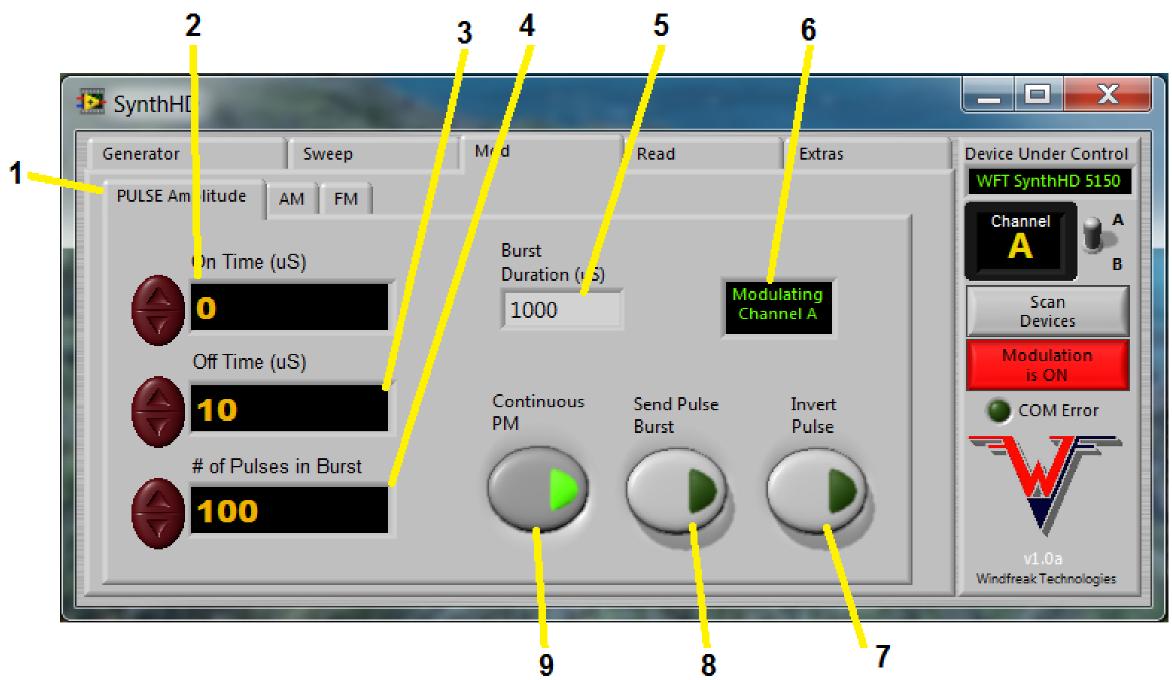


Figure 3 – Mod Tab – Pulse Amplitude Modulation

1. **Pulse Amplitude Modulation.** This Modulation Tab controls RF Pulsing or On-Off-Keying (OOK). Peak pulse power is controlled in the Generator Tab with the RF power control knob. Pulse drive is controlled two ways depending on frequency. At lower frequencies the PLL chip RF output power down pin can be used, which is high speed and can create pulses as narrow as 1uS. At frequencies above 4GHz, the on / off RF isolation from driving this pin is too low. In that case, the VGA D/A gain bias voltage is used. Above 4GHz the minimum pulse width is about 20uS due to the slower speed of driving the VGA.
2. **On Time.** Sets the amount of time the RF is ON in microseconds.
3. **Off Time.** Sets the amount of time the RF is OFF in microseconds.
4. **# of Pulses in Burst.** Sets the number of pulses sent in one burst. This number is limited to a maximum of 5000 and should be at least 1. Higher numbers may reduce jitter since the processor will concentrate more on pulsing and less on other things like checking USB.
5. **Burst Duration.** Calculates the approximate time a burst will last.
6. **Modulation Readout.** Shows which channel is being modulated since it is possible to start modulation on one channel, then change channels to adjust CW values on the other channel. (Modulating both channels at the same time is not possible.)
7. **Invert Pulse.** This feature is needed if other modulations are required INSIDE the pulse. Normally the SynthHD program will turn on the RF, delay for the on time, turn off the RF, delay for the off time, and then go service other routines like USB communication and other modulations. After setting the Invert Pulse button, the order is reversed so that the RF is left on during the servicing of those routines. For example this allows you to do an FM chirp during the pulse on time.

When Invert Pulse is ON, the On Time and Off Time get reversed, but it's not obvious on the GUI. A pulsed FM chirp setup example is given towards the end of this manual. Finally, since the PAM feature could be used on power amplifiers where the average power is much less than the CW power, RF power is left off after turning off Continuous Pulse Modulation. This helps protect power amplifiers. To get RF power back on clicking a tab on the GUI will bring it back.

8. **Send Pulse Burst.** Sends just one pulse burst as long as the number of pulses in the burst.
9. **Continuous PM.** Turns on Pulse Mod indefinitely until it is turned off again.

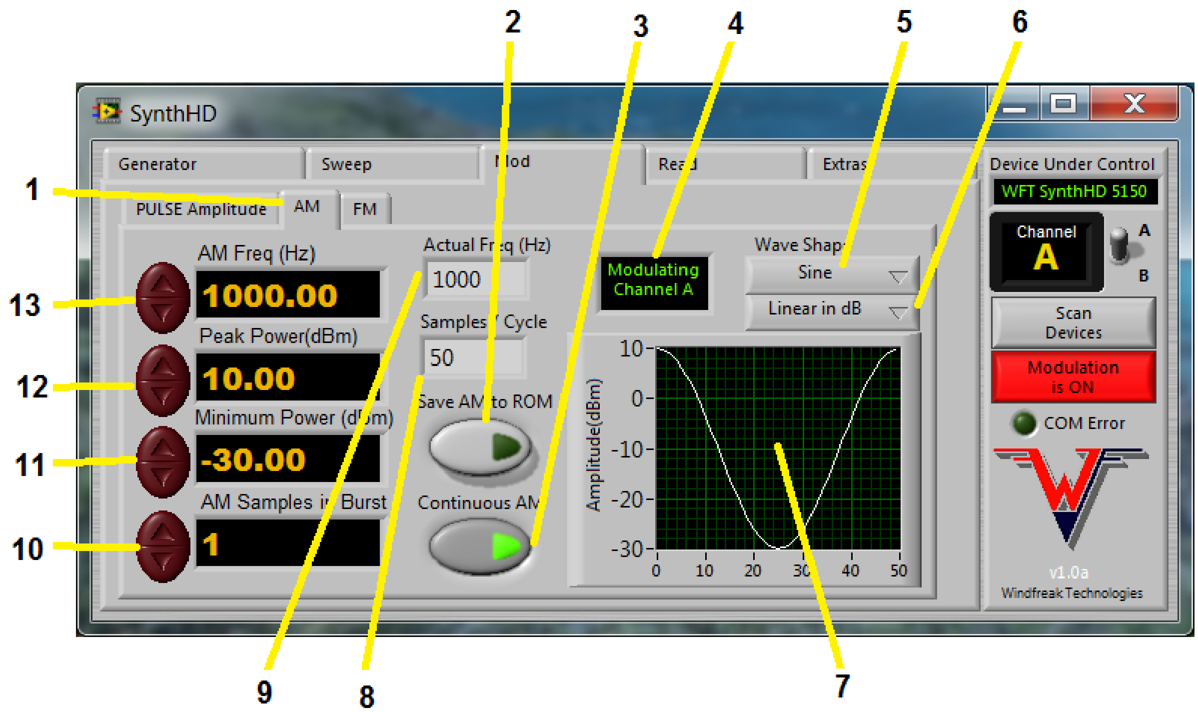


Figure 4 – Mod Tab – Amplitude Modulation

1. **Amplitude Modulation Tab.** Amplitude modulation is driven by high speed 16 bit digital writes to a D/A that then drives the VGA. Sample rate is roughly 20uS per point. AM frequency is derived by an algorithm that adjusts the number of samples per cycle and the delay per sample. This allows for AM modulation frequencies upto about 5KHz.
2. **Save AM to ROM.** Saves the AM signal to non volatile memory so AM can be run right after power up without a PC connected.
3. **Continuous AM.** Turns AM on and off. After turning AM off, the RF power will be at a random RF amplitude depending on where in the cycle it turned off. Click another tab to reset to the Generator Tab settings.
4. **Modulation Readout.** Shows which channel is being modulated since it is possible to start modulation on one channel, then change channels to adjust CW values on the other channel. (Modulating both channels at the same time is not possible.)

5. **Wave Shape.** Choose between Sine, Ramp, or Triangle AM shapes.
6. **Linear in dB or Volts.** Choose if your wave shape will be linear in dB or Volts. A spectrum analyzer in zero span mode with a vertical axis in dB will show a nice waveform if the setting is linear in dB. If you are driving an envelope detector, which detects volts, it might be best to use linear in volts.
7. **Wave Shape Display.** Shows the approximate shape (in dB) of the wave.
8. **Samples per Cycle.** Display used to know how many samples are in a given cycle, which is important when combining modulations.
9. **Actual Frequency (Hz).** Shows the approximate frequency of the AM modulation since there is some error due to sample rate limitations.
10. **AM Samples in Burst.** Used when combining modulations. Leave at 1 or increase to possibly help jitter.
11. **Minimum Power.** AM RF power is determined by minimum and maximum power in this tab and is not affected by the RF Amplitude controls on the Generator Tab. Minimum power controls the minimum power excursion of the wave.
12. **Peak Power.** Sets the maximum power excursion of the wave. See the Wave Shape Display for the final wave shape and amplitudes.
13. **AM Frequency.** Amplitude Modulation Frequency in Hz.

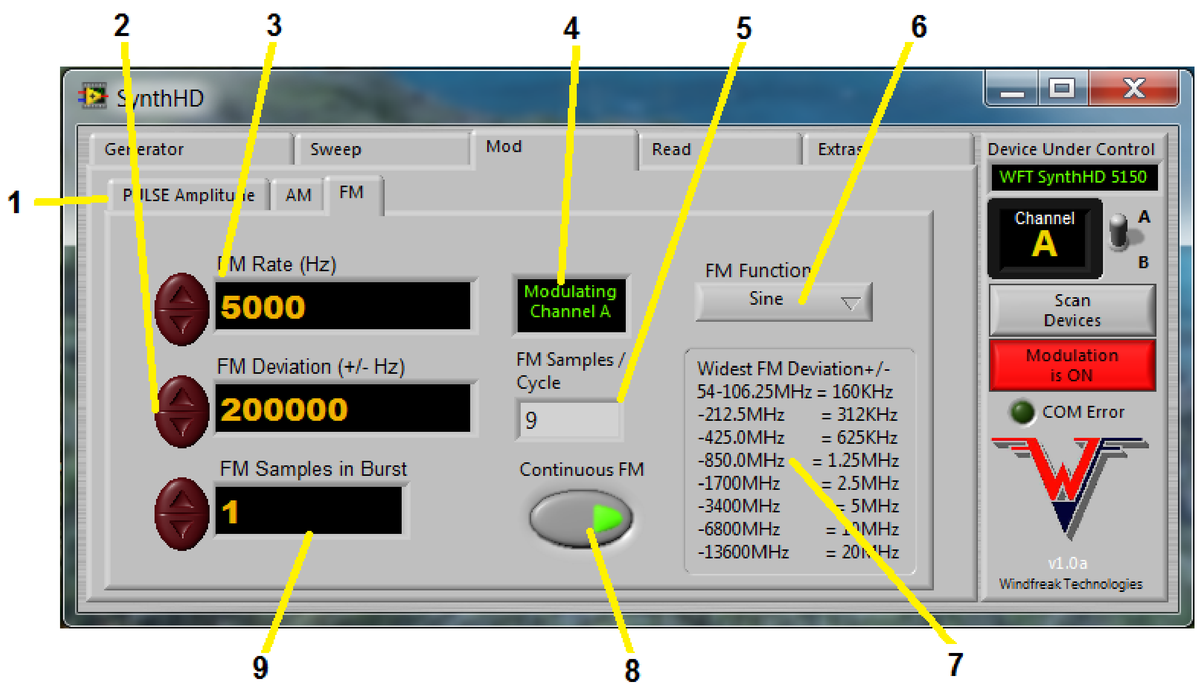


Figure 5 – Mod Tab – Frequency Modulation

1. **Frequency Modulation Tab.** Frequency modulation is driven by high speed 64 bit digital writes to the PLL chip. Sample rate is roughly 20uS per point. FM frequency is derived by an algorithm that adjusts the number of samples per cycle and the delay per sample. This allows for FM modulation frequencies up to

about 5KHz. It's possible to adjust the PLL loop filter cutoff frequency to help smooth out the quantization steps.

2. **FM Deviation.** Sets the FM deviation around the center frequency in +/- Hz.
3. **FM Rate.** Sets the FM frequency in Hz. Actual frequency may have small errors due to sample rate limitations.
4. **Modulation Readout.** Shows which channel is being modulated since it is possible to start modulation on one channel, then change channels to adjust CW values on the other channel. (Modulating both channels at the same time is not possible.)
5. **FM Samples / Cycle.** This display is used when combining modulations together such as a pulsed FM chirp. It allows you to get the full cycle into one pulse.
6. **FM Function.** Choose between a sinusoidal FM shape, or an FM Ramp (Chirp).
7. **Widest FM Deviation Table.** Maximum FM deviation depends on frequency. The higher the frequency the more deviation is allowed up to a total of +/- 20MHz.
8. **Continuous FM.** Turn FM modulation on and off.
9. **FM Samples in a Burst.** Normally set this to the number of Samples in the Cycle when combining modulations such as doing a pulsed chirp.

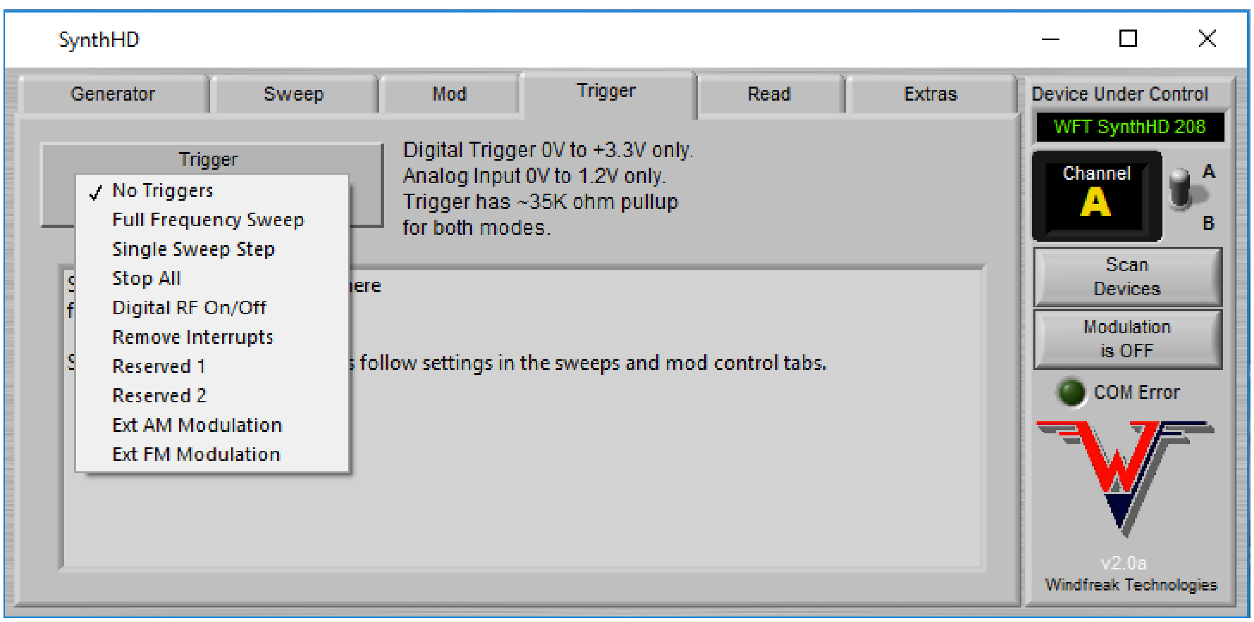


Figure 6 – Trigger Tab

The trigger connector on the SynthHD is a multi-function input for controlling the device in ways detailed below. Digital triggering requires standard 3.3V CMOS input. Analog modulation inputs are DC coupled between 0V and 1.2V. Both modes have a ~35K ohm pullup resistor to 3.3V. *For FM and AM modulations, it is required to set up internal FM or AM modulations as described below before using external modulation. For linear Vin Vs Mod Out the internal modulation HAS to be set to Chirp for FM or Ramp for AM.*

1. **No Triggers.** This mode disables the trigger input and allows the SynthNV to be controlled fully by software.

2. **Full Frequency Sweep.** Detailed in Figure 2 and Figure 3 Item 10.
3. **Single Sweep Step.** Detailed in Figure 2 and Figure 3 Item 10.
4. **Stop All.** Stop All puts a "do nothing" hold on the SynthHD operating system. It only responds to the Trigger and to USB communication. This allows you to trigger bursts of pulses or other modulations.
5. **Digital RF On/Off.** Quickly mutes the RF power when low. A high level restores RF power to the GUI setting. (Pulse Mod)
6. **Remove interrupts.** Remove interrupts reduces jitter in modulations that are timing critical such as radar chirp. When Trigger is pulled low RF is ON and Interrupts are off. When Trigger is high RF is OFF and the SynthHD will respond to USB commands. *Warning! This mode blocks USB communications when the trigger signal is pulled low. Clicking any controls wile in this mode will cause the software to lock up, possibly requiring reboot of the PC. Disconnect everything from the trigger, allowing it to float high, and exit this mode before resuming normal operation.*
7. **External AM Modulation.** External AM Modulation is driven through the Trigger connector and responds to analog voltages between 0 and 1.2V. It responds to settings stored in the AM look up table and cycles through each sample. For best performance set the AM frequency to 1Hz which gives the maximum of 100 samples. Set the wave shape to RAMP and select whether you want the response linear in dB or Volts. 0V input will correspond with the Minimum Power setting and 1.2V will drive to the Peak Power setting with 100 steps in between. Sample rate is roughly 22uS.
8. **External FM Modulation.** External FM Modulation is driven through the Trigger connector and responds to analog voltages between 0 and 1.2V. It responds to settings stored in the FM control tab and cycles through each sample it creates. For best performance set the FM frequency to 1Hz which gives the maximum of 100 samples. Set the wave shape to CHIRP. 0V input will correspond with the (neg) FM Deviation setting and 1.2V will drive to the (pos) Deviation setting with 100 steps in between. Sample rate is roughly 22uS.

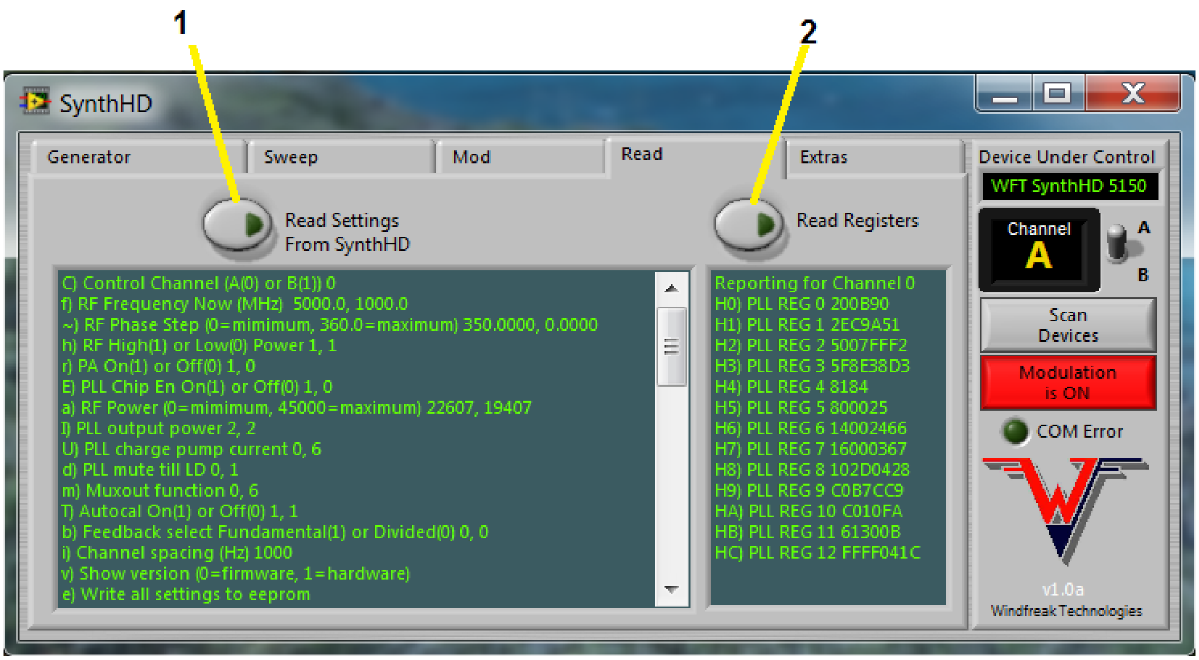


Figure 7 – Read Tab

1. **Read Settings from SynthHD.** Investigate all settings reported by the SynthHD. If there are any issues with the device, Windfreak Tech Customer Service may ask for a copy and paste of this data.
2. **Read Registers.** Get the exact register settings for the PLL chip. Toggle the Channel Selector Switch to get both channels data.

Figure 8 – Extras Tab (Plus Pull Down Bottom Edge)

1. **Read Version.** Click to get the Firmware and Hardware versions of the SynthHD. Official SynthHD firmware can only be updated at the Windfreak Technologies Headquarters in Florida. Older firmware operating with newer software may have problems with some features. Version 2 Software only applies to SynthHD Serial # 208 and higher.
2. **Mute Till Lock Detect.** This feature turns off the RF during frequency changes. The PLL chip goes through calibration routines that can generate a large amount of RF noise. In certain circumstances the MTLD feature is turned off automatically by the SynthHD. These are: When Feedback Mode is divided and the RF frequency goes below about 250MHz, and when FM is turned on. It will automatically go back to the user setting once out of these situations.
3. **Feedback Mode is Divided.** This controls an architectural feature inside the PLL chip and how the RF dividers work. Feedback Mode NEEDS to be divided in order for phase adjustment to work across all frequencies so this is the default setting. The drawback is when producing low RF frequencies the lock detect circuit in the chip does not work. If you don't need phase adjustment, and you need to operate at the lower frequencies below about 250MHz, it might be good to set the Feedback Mode to Fundamental which will give good Lock Detect LED performance across the whole operating band.
4. **Mux Out Select.** Mux Out is a pin on each PLL chip that feeds back the Lock Detect signal to the SynthHD microprocessor. In general, it's not advised to set it to anything other than digital lock detect, although setting it to Vdd will light the

Lock LED and report phase lock to the GUI for testing purposes (even though there might not be lock). During FM modulation, the Mux Out is automatically adjusted to HiZ and then back to the user setting after FM is turned off.

5. **PLL ICP.** This adjusts the PLL Charge Pump Current, which in turn changes the response of the PLL loop filter. Values between 0 and 15 can be set. The nominal loop filter bandwidth is about 12KHz. Going below 7 will decrease this and going above 7 will increase it. This could help in smoothing out some of the quantization noise when doing Frequency Modulation. Otherwise it is advised to leave it set at the factory default setting.
6. **Pull down edge Serial Port Select.** The SynthHD talks to the computer through its virtual serial port. The GUI tries to find SynthHD's on the USB bus but the port can be manually selected here.
7. **Pull down edge Stop Running.** When modifying the Labview Source Code, use this button to stop running the program to edit it.
8. **Pull down edge Dual Displays.** It is sometimes helpful to always see what the Frequency and Power Settings are for each channel. This makes it easy.
9. **Save Settings to ROM.** Save all settings from the GUI to the SynthHD hardware nonvolatile memory bank. These settings will be remembered, even after powering down the hardware. The device can fire up without a computer in any state, including modulations.
10. **Get Phase Lock Status.** Push and hold this button to check for phase lock status. As previously noted, the SynthHD does not always report lock even though it may be locked. Read #3 and #4 in this (Extras Tab) section for more info.
11. **Get Temperature.** Click here to read the temperature inside the SynthHD. There is only one temperature measurement point inside the HD and it is closest to channel A. It is advised to increase airflow to the device and or heat sinking if this value goes above 50 degrees C.
12. **Program Reference.** There are 3 options used to set the reference of the SynthHD. To set the internal 10MHz or 27MHz reference, click the pulldown and select either of the internal references. To program an external reference, click the pulldown and select“External”, then enter in the reference frequency in the box below. The frequency of the externally supplied reference should be between 10MHz – 100MHz at an amplitude of about +10dBm.

Creating Multiple Modulations – An FM Chirp Worked Example.

It is possible to have multiple modulations running on a single channel with the SynthHD. This is particularly handy when trying to create a Chirped FMCW pulse at any given interval.
It is a good idea to understand how the SynthHD firmware program works. The SynthHD has a single core, single thread, 32 bit ARM microprocessor on board. The program first checks for USB communications. If any USB communication comes in, it drops everything to go handle it – assuming the trigger setting is not on "Remove Interrupts". It then checks for any modulation enabled.

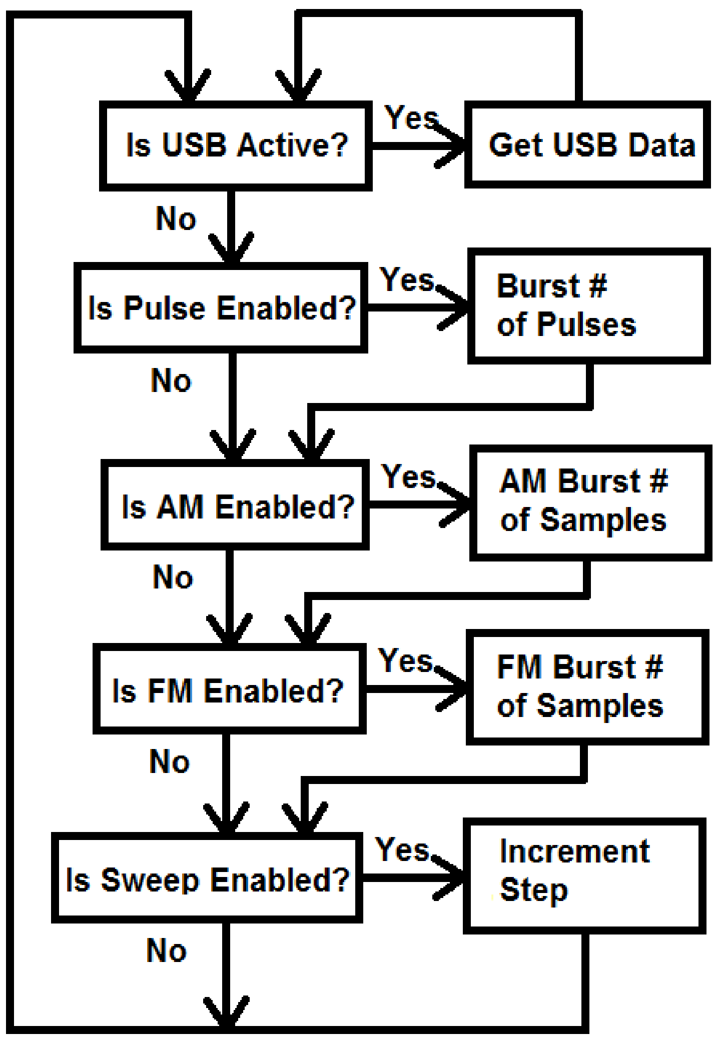


Figure 9 – Firmware Program Flow

Pulse Modulation Subroutine:
Under a pulse modulation only scenario the pulses are not inverted and have a given on time and off time. In this case, the pulse routine will turn on the RF for the on time, and

turn off the RF for the off time settings in the pulse subroutine. The On time and Off time settings are delays where the program does nothing but wait for the delay to finish. This is RF CW time. If you have # of Pulses greater than 1 it will repeat until the burst is done and then go on to the rest of the program. While it is running the rest of the program, the RF is turned off. The main reason for this is to protect high power pulse amplifiers from full CW power when you send a USB command to stop pulsing. If nothing else is set to happen with the rest of the program, including USB communication, the time to service is very small and basically the pulse modulation is continuous.
When using Pulse with other modulations there are 3 caveats to keep track of:

1. The main caveat is that you need the RF to be ON while doing the other modulations. This can be done by clicking the Invert Pulse Button. This also inverts the On time and Off time. Now you need to mentally keep track that On time is really Off time and vice versa!
2. The second caveat is to keep the # of Pulses at 1. This keeps the pulse routine to only 1 cycle. It turns off for the duration of the On Time setting, and turns on to go service other modulations.
3. Finally, On Time and Off Time are purely do nothing (for x time) settings. Since you want to modulate while RF is on, and since these settings are inverted, you would set Off Time to the smallest possible value allowed to keep CW time to a minimum. Set the On time to the delay between pulsed modulations. At this point your actual RF ON modulation time is set by the Burst Duration in the desired modulation tab (AM or FM).

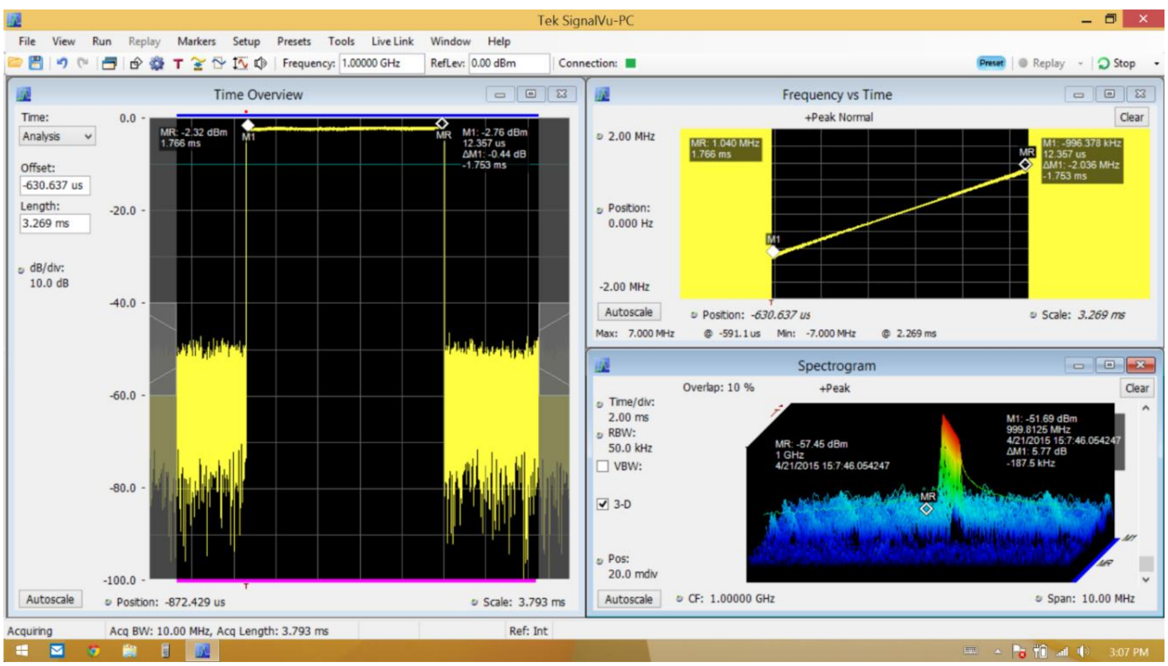
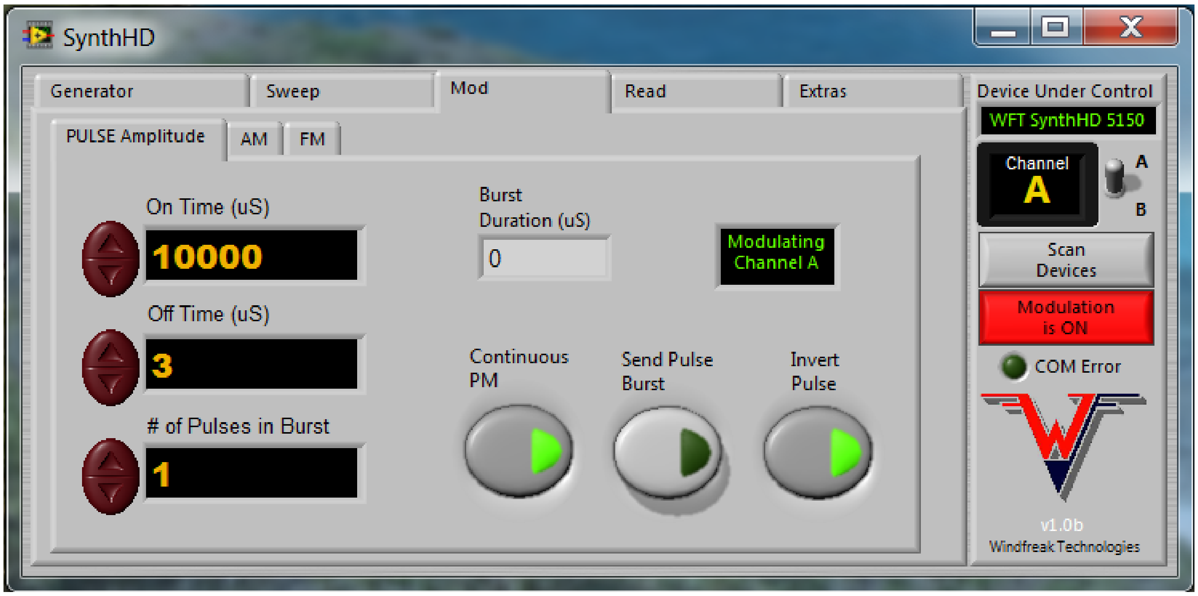
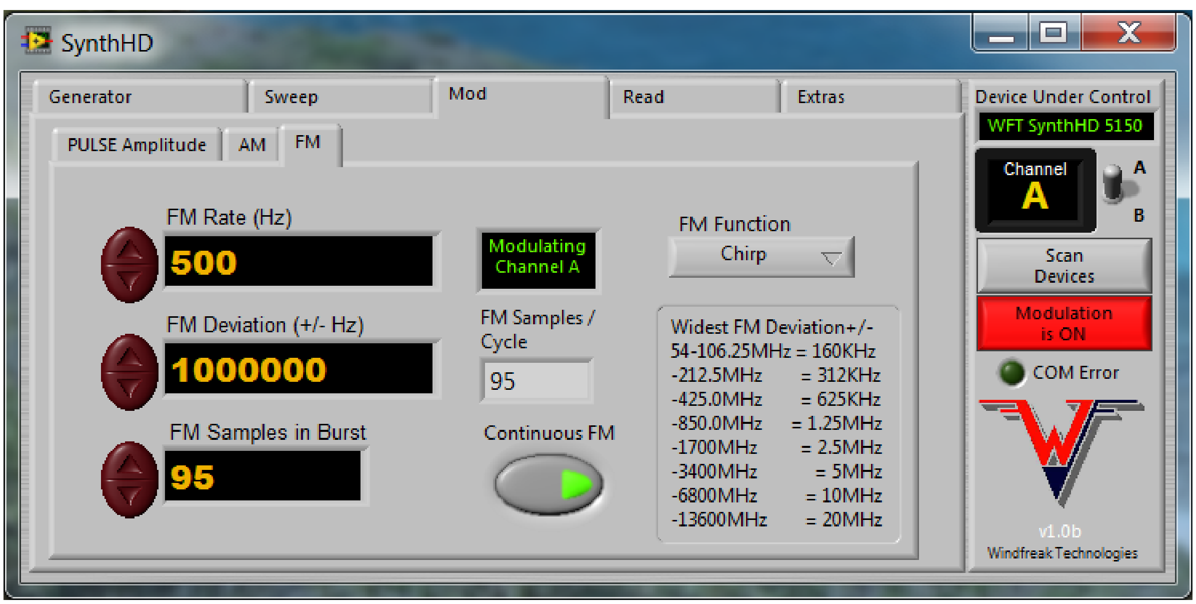


Figure 10 – FMCW Pulsed Chirp

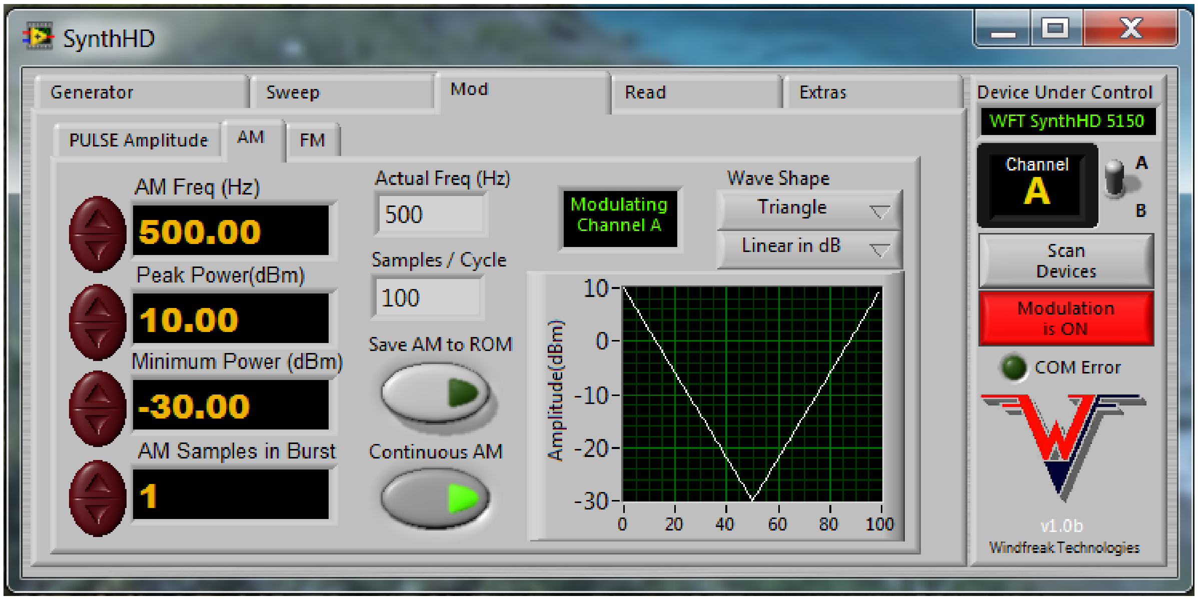
In the FMCW Pulsed Chirp of Figure 10 the two markers (M1 and MR) show the beginning and ending of the RF Pulse in all three panes. The first pane on the left shows the pulse as power vs time, which comes up from the noise to about -2.5dBm. The top right pane shows the demodulated FM ramp as frequency vs time going from -1MHz to +1MHz either side of the RF carrier in 1.753mS. The bottom right pane shows them both in a 3D spectrogram.

The settings on the SynthHD GUI for the chirp in Figure 10 are as follows:





Simulation of linearly fading in and out could be achieved by also using AM Modulation:



Conclusion:

There are may opportunities to enhance the firmware and software for the SynthHD in the future such as, but not limited to, enhanced phase control and data communications using AM, FM and PM modulations, as well as bug fixes. Data rates won't necessarily be high due to the lower sampling rates in the 20uS range, but this could prove valuable to some people. If you have read through this document, you probably understand the capabilities of the hardware that are yet untapped. If you have a need that is not addressed, but possible with this technology, please feel free to contact Windfreak Technologies to discuss. Windfreak Tech is a small, hungry company that does things for less money than you might expect. The owners love the business and care most about the happiness of its customers and the usefulness of its devices. Sometimes, depending on circumstances like volume, development of custom features or custom firmware could cost nothing.

Sincerely,
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