Agilent 33120A Signal Generator

UTA Quick Guide

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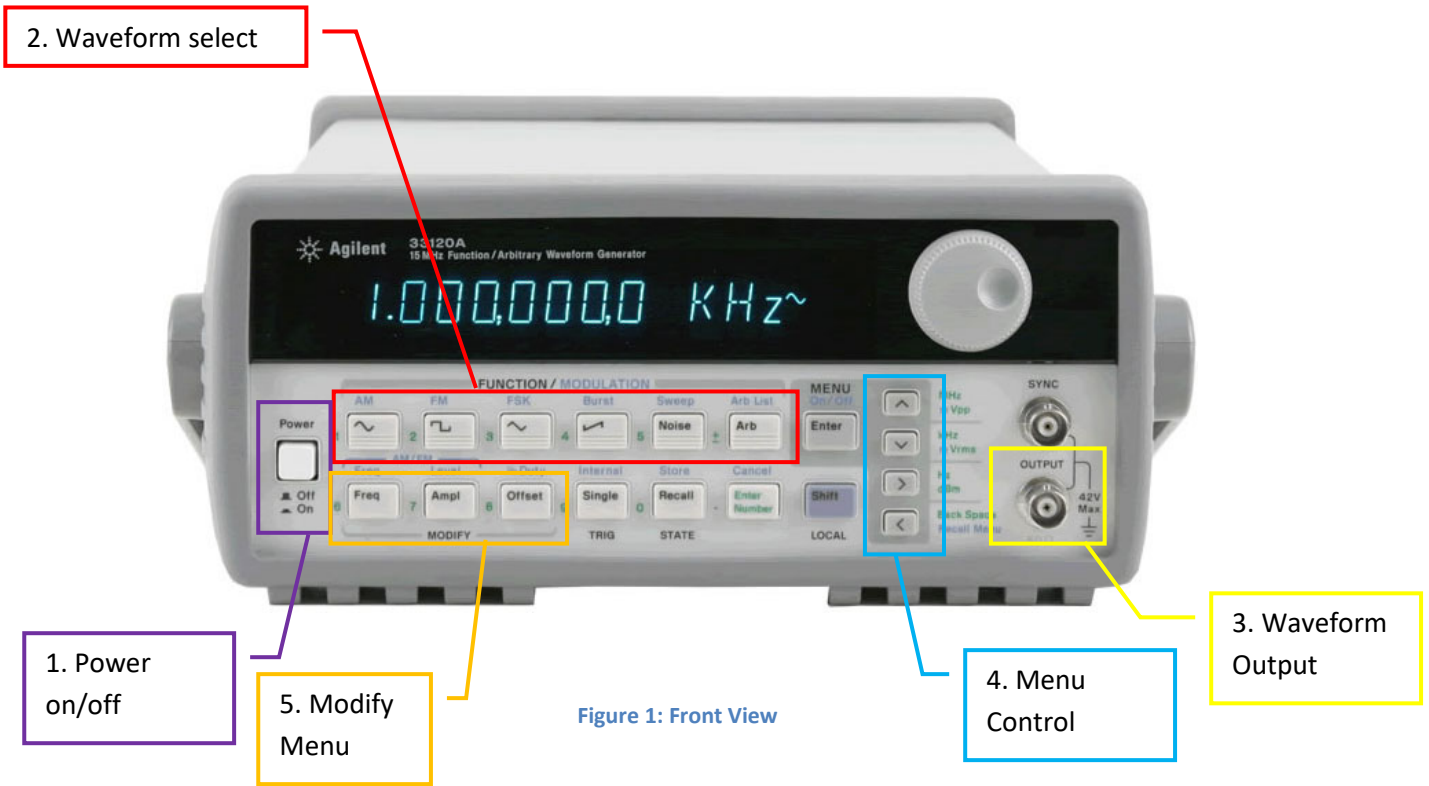4. Menu Control

1. Power on/off. When powering on the unit, the 33120A performs a self test. If the self test fails, contact a lab technician.
2. Waveform select. Choose from Sine, Square, Triangle, Ramp, Noise and Arbitrary. Selecting the shift key first lets you access Amplitude Modulation, Frequency Modulation, Frequency Shift Keying, Burst menu, Sweep menu, and the Arbitrary list.
3. Output. This type of connector is called a BNC. The output has two modes. 50 Ohm impedance or high impedance (High Z).
4. Menu Control. Use the four arrow buttons to move the cursor on the display and navigate through the menu.
5. Modify Menu. Set the Frequency, Amplitude and D.C. offset of the output.

Prerequisites

In order to measure the signals coming from the Agilent 33120A signal generator, you need to be able to understand and operate an oscilloscope. You should read the UTA Quick Start Guide for the Tektronix TBS 1052B-EDU Oscilloscope (http://www.uta.edu/ee/current-students/UG-lab/user-guides/Tektronix-TBS1052B-EDU-UTA-Quick-Guide.pdf) before proceeding with this guide.

Setting up a Sine Wave

1. Turn on the Agilent 33120A signal generator and connect a BNC to Grabber cable to the **OUTPUT**. See figure 2.
2. Turn on the oscilloscope and connect an oscilloscope probe to channel 1 on the oscilloscope.
3. Connect the oscilloscope probe grabber to the red grabber from the signal generator.
4. Connect the oscilloscope probe ground to the black grabber from the signal generator.
5. Press AUTOSET on the oscilloscope.
6. Ensure the oscilloscope probe is a x10 probe and channel 1 is set to x10.
7. You should see a 1 kilohertz sine wave on the oscilloscope around 200 mVpp.
8. Press **Ampl** on the signal generator. Notice the signal generator is set to 100mVpp, yet the oscilloscope measures around 200mVpp. This happens because the output impedance is defaulted to 50 ohms.
9. **ATTENTION: YOU MUST CHANGE THE OUTPUT IMPEDANCE EACH TIME YOU POWER ON THE SIGNAL GENERATOR!** To change the output to high impedance, press **Shift** -> **Menu On/Off**. Press the **right arrow** 3 times to access the *D: SYS MENU.* Press the **down arrow** key twice to reach the output impedance (*50 OHM*) screen. Press the **right arrow** key to select *HIGH Z* then press the **Enter** key. The Amplitude on the signal generator should now read 200mVpp.

Figure 2: BNC to Grabber

Adjusting the Amplitude

There are two methods for adjusting the amplitude.

Method 1

Press the left and right arrow keys to select a digit on the display, then spin the wheel to increase/decrease the value.

Method 2

Press the button **Enter Number**, it has green lettering, then type in your desired value using the green numbers to the left of the buttons. Then choose the correct arrow key, in our case we'll choose **Vpp** for amplitude peak to peak.

Adjusting the Frequency

The frequency is set in the same manner as the amplitude. The arrow keys offers MHz, kHz and Hz instead of Vpp, Vrms, and dBm.

Offset

Notice the sine wave has no D.C. element. Press the **Offset** button and slowly spin the wheel left and right to change the D.C. offset of the signal. (Make sure the oscilloscope is set to D.C. coupling)

Wave forms

The Agilent 33120 A is capable of outputting many different waves.

Sine

We have already learned how to adjust the amplitude and frequency of a sine wave. A very pretty wave to be sure, but let's see what charm the other waves have.

Square

1. Press the **square wave** button and adjust the amplitude to 5Vpp and set the frequency to 1kHz.
2. Press the **Offset** button and set it to +2.5 VDC.
3. You now have a 5V clock pulse you can use with your circuits.
4. We can also change the duty cycle of the square wave.
5. Press **Shift** -> **%Duty**. Move the wheel to change the duty cycle. You can adjust the duty cycle from 20% up to 80%.

Triangle/Sawtooth/ Noise

1. Press the **triangle wave** button and observe on the oscilloscope.
2. Adjust the D.C. Offset to 0.0 VDC.
3. Press the **sawtooth wave** button and observe on the oscilloscope.
4. Press the **Noise** button and observe on the oscilloscope.

Arb (Arbitrary) (Sinc, Neg Ramp, Exp_Rise, Exp_Fall, Cardiac)

1. Press the **Arb** button and observe on the oscilloscope.

2. You will probably see the Sinc waveform (the default for Arb). See Figure 3.
3. To access the entire list of arbitrary waveforms press **Shift** -> **Arb List.** Then use the right or left arrow keys to scroll through the arbitrary list. Select *NEG_RAMP* and press the **Enter** button. Repeat this step to view the other arbitrary waveforms. See Figure 4.
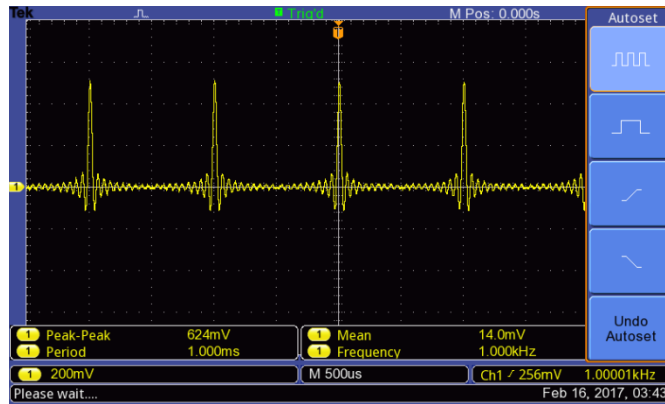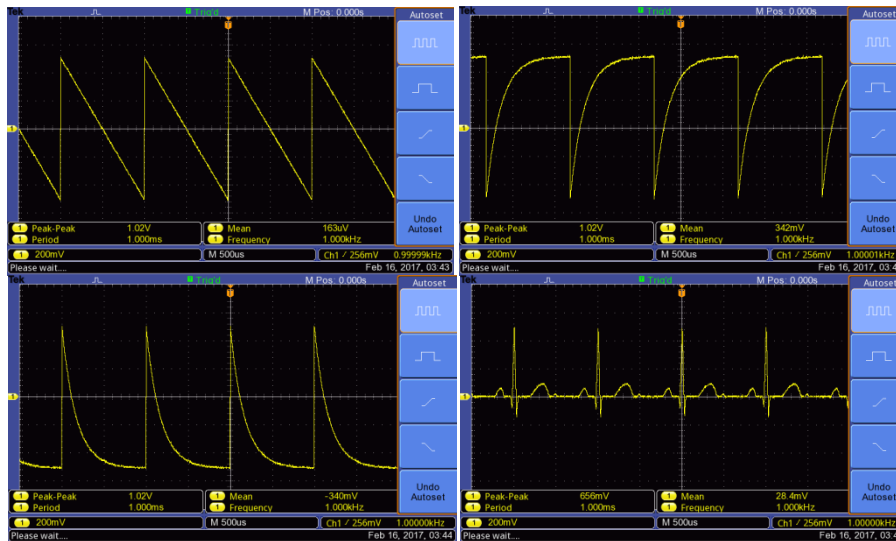

Figure 3: Sinc waveform.

Figure 4:
Top left – Negative Ramp, Top right – Exponential rise,
Bottom left – Exponential fall, Bottom right – Cardiac.

Burst

Normally the Agilent 33120A signal generator sends a continuous signal. You can change this by setting up burst mode. Observe the output of the signal generator with the oscilloscope to see how burst mode works.

1. Set the frequency to 1kHz and the amplitude to 1 Vpp.
2. Press the **Shift** button then press the **Burst** button.
3. The default burst count is set to 1 cycle to be outputted every 10 ms or 100Hz. See Figure 5.
4. To change the burst count press **Shift** -> **MENU**. This brings up the *A: MOD MENU* (Modulation menu). Press the **Down Arrow** to access the sub menu. Press the **Right Arrow** three times to access the *4: BURST CNT* option. Press the **Down Arrow** to access the Burst count options menu.
5. Use the wheel or enter the number 5 into the signal generator. In the Oscilloscope's Trigger Menu page 2 of 2, set the oscilloscope's trigger holdoff to 4.100 ms to stabilize the signal.
6. You should now see 5 complete cycles bursting every 10 ms. See Figure 6.
7. To change the rate of the burst press **Shift** -> **ENTER** -> **Down Arrow -> Right Arrow x4** -> **Down Arrow**. Type in 150 Hz and observe on the oscilloscope. See Figure 7.

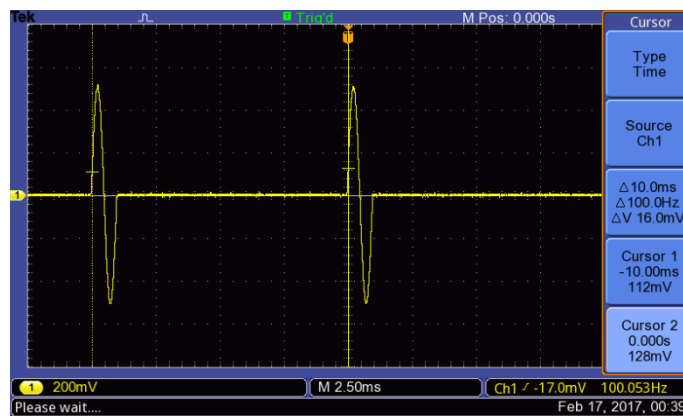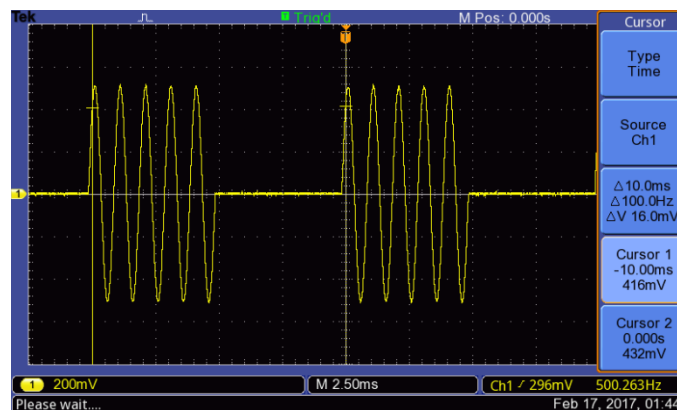**Figure 5: One complete cycle of a 1kHz sine wave every 10ms (100Hz).**

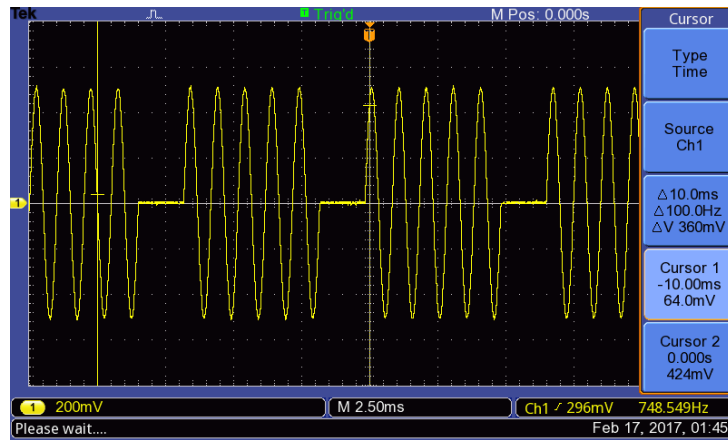**Figure 6: 5 complete cycles of a 1kHz sine wave every 10ms (100Hz).**

Figure 7: Five complete cycles of a 1kHz sine wave every 6.7 ms (150Hz).

Setting up a Sweeping Frequency

There are times when you will want to sweep certain frequencies through a circuit. Testing the frequency response of a bandpass filter is a good example.

1. Set the frequency to 1kHz and the amplitude to 1 Vpp. Ensure the signal generator is in High Z mode.
2. To turn the sweep mode on and off simply press **Shift** -> **Sweep**.
3. To set the start frequency press **Shift** -> **MENU** -> **Right Arrow** -> **Down Arrow** ->**Down Arrow** then enter the start frequency and press the **Enter** button.
4. To set the stop frequency press **Shift** -> **MENU** -> **Right Arrow** -> **Down Arrow** ->**Right Arrow** -> **Down Arrow** then enter the stop frequency and press the **Enter** button.
5. To set the sweep time press **Shift** -> **MENU** -> **Right Arrow** -> **Down Arrow** ->**Right Arrow** -> **Right Arrow** -> **Down Arrow** then enter the sweep frequency and press the **Enter** button.

Modulation

A sine wave by itself is pretty meaningless. Modulation is the act of varying a wave to convey information. The Agilent 33120A can modulate a frequency (called a carrier frequency because it carries information) with three common modulation techniques.

Amplitude Modulation

1. First, let us set the frequency to a real A.M. radio frequency. Set the frequency to 820 kHz and the amplitude to 1 Vpp. There is an A.M. Radio in the lab (ask the staff to borrow). Place the red wire from the grabber near the A.M. radio antenna and leave the oscilloscope hooked up to the signal generator so you can observe the signal. Note: The A.M. radio will pick up noise (signals from the test equipment), so place the radio far away from the signal generator and oscilloscope.

2. You might be able to hear a local A.M. station, but we are going to overpower the signal with the signal generator. Press **Shift** -> **AM** to turn on the amplitude modulation.

3. Set the oscilloscope to 200 mVpp and 2.50ms. See figure 8.

4. Press **Shift** -> **Freq**. The signal generator now displays *MOD 100.0 Hz*. The default is 100 Hz. Too low for you to hear on the radio.

5. The AM/FM Frequency menu will turn off automatically after a few seconds so you will need to press **Shift** -> **Freq** again and enter 1kHz quickly. If the A.M. radio is tuned correctly, you should hear a 1kHz tone, if not adjust the A.M. radio until you hear it. Notice there are 10 times more cycles on the oscilloscope because we went from 100Hz to 1000Hz. Repeat this step and try other frequencies to test your hearing. By changing HOW FAST we raise and lower the AMPLITUDE of the carrier frequency we convey the frequency (pitch) of a second wave (the information, E.g. a low frequency voice wave).

6. Set the Amplitude to 500mVpp. The volume on the radio lowers. This is like driving away from a radio station, there is less signal going into the antenna. This is not how we convey the amplitude of the information. Set the amplitude back to 1Vpp. Press **Shift** -> **Level**, the signal generator displays *100% DEPTH*. Change this value to *000% DEPTH*. Notice the 820 kHz wave on the oscilloscope has no change in amplitude. See figure 9. The amplitude is a constant 1Vpp. This conveys no amplitude of the information, E.g. the radio host is not talking. Press **Shift** -> **Level** again and set the Depth to 50 %. See figure 10. By not reducing the carrier amplitude to 0 Vpp we can convey the amplitude or volume of the information.
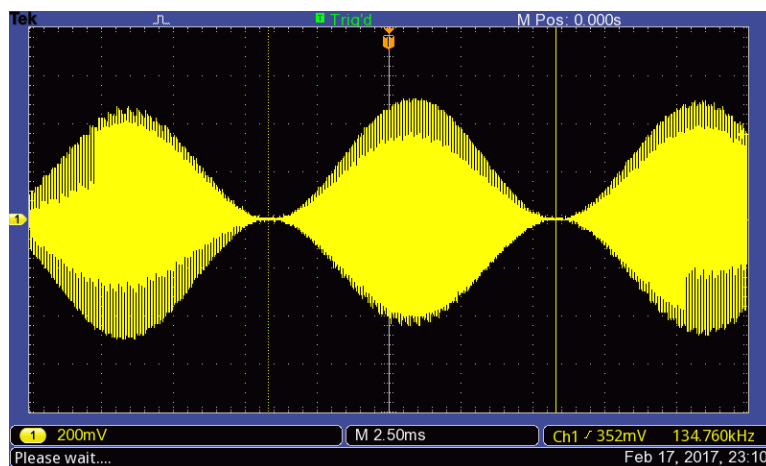

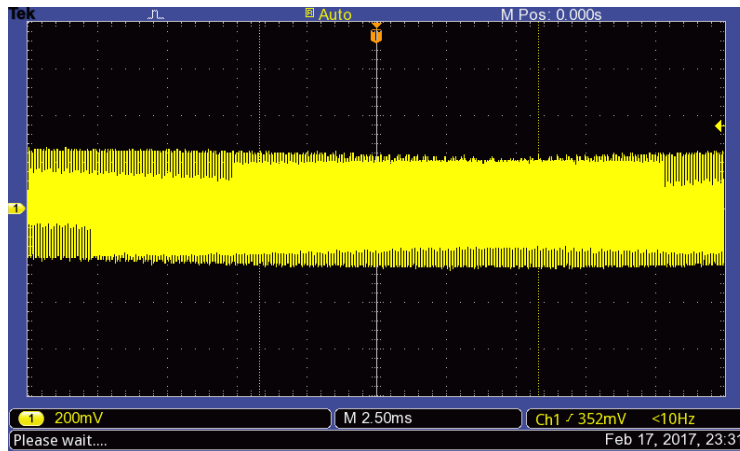**Figure 8: 820 kHz, 1 Vpp with 100Hz A.M. Modulation**

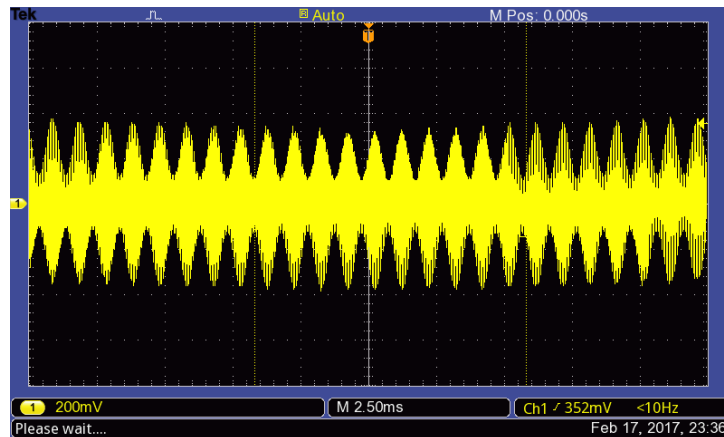**Figure 9: carrier frequency with no A.M. modulation**

Figure 10: 50 % Depth of an A.M. signal.

Frequency Modulation

Frequency modulation varies the frequency of the higher frequency carrier wave to convey the frequency and amplitude of another lower frequency wave.

1. Set the signal generator to 1kHz and 1Vpp. Be sure the signal generator is in HIGH Z mode.
2. Press Autoset on the oscilloscope.
3. Press **Shift** -> **FM** on the signal generator.
4. The default FM frequency is 10Hz. The default F.M. Deviation is 100 Hz.
5. To see F.M. signals better we are going to use the FFT Button on the oscilloscope. Press FFT on the oscilloscope and change the horizontal scale to 250Hz. The oscilloscope is working like a spectrum analyzer in FFT mode. The horizontal represents frequency now, not time. You should see a signal similar to figure 11.
6. Press **Shift** -> **FM** to turn the FM off. This is the carrier frequency with no frequency modulation.
7. Press **Shift** -> **FM** to turn the modulation back on. Change the oscilloscope horizontal scale to 1.25kHz. Press **Shift** -> **Freq** and enter 1 Hz. You should now see the carrier move back and forth each second. How <u>FAST</u> the frequency deviates conveys the frequency of the information, E.g.

the pitch of your voice. Press **Shift** -> **Freq** again and slowly increase the MOD frequency to 100Hz. Adjust the oscilloscope horizontal back to 250Hz.

8. The amplitude of the information, E.g. The volume of your voice, is conveyed by how far the carrier deviates back and forth. Press **Shift** -> **Level** and change the deviation to 500 Hz. This represents a larger amplitude. Small deviation conveys a small amplitude and a large deviation conveys a large amplitude. See figure 12.

9. Press **Shift** -> **FM** to turn off the frequency modulation.
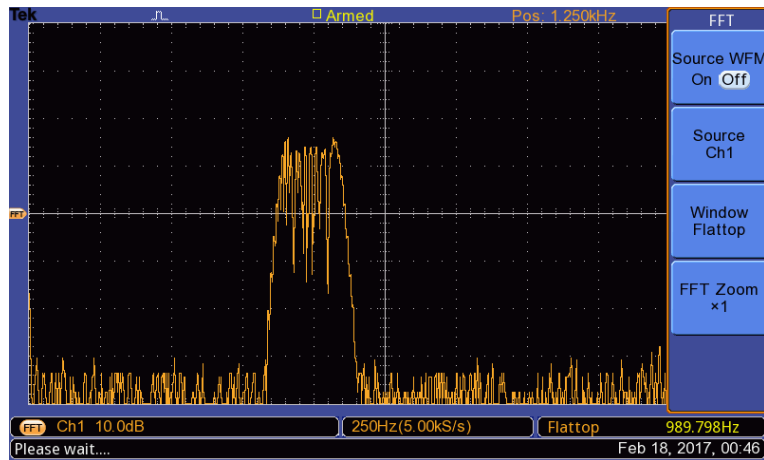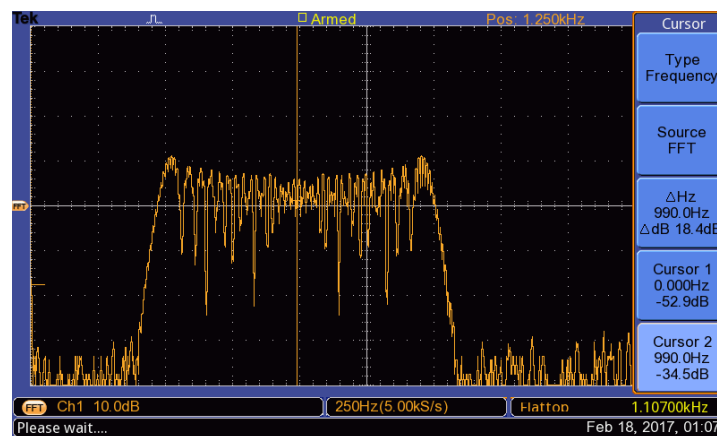

Figure 11: FM modulation

Figure 12: FM modulation with larger deviation.

Frequency Shift Keying (FSK)

Frequency shift keying is digital modulation. Lowering the carrier frequency by a set amount represents a logic 0 and raising the carrier frequency by a set amount represents a logic 1. The data being transmitted by the signal generator is just a stream of alternating 1's and 0's. If you want to control the data being modulate please see the UTA EE Undergraduate staff.

Saving and Recalling

Navigating the menu can be quite difficult on the Agilent 33120A. If you have a certain setup you use over and over, it is a good idea to store the settings. You can then recall your settings with two button presses. You can store up to three different setups.

1. Set the signal generator up with the exact signal you want.
2. Press **Shift** -> **Store** and select 1,2 or 3 then press the **Enter** button.
3. To recall the setup, press **Recall** then use the wheel to choose 1,2 or 3. Press the **Enter** button.
4. **Note: The 50 ohm / High Z information is also stored into memory as well.**

More Information

This UTA Quick Guide is intended to familiarize students quickly with the undergraduate lab equipment. For more information on the Agilent 33120A signal generator please contact EE_UG_LABS@uta.edu to schedule addition training.